

General

MD_Downlink is developed by microdrones GmbH.

The data is transmitted via the audio channel of the video transmitter.

Encoder

Supply	3V3DC (supplied by onboard flight-controller)
Modulation type	PIPS (Phase Independent Permanent Synchronized)

Decoder

Supply voltage	5VDC @18mA (supplied by USB of PC / Notebook)
Input	Receiver Audio out
Output type	USART (38400,n,8,1), ASCII

For identification of firmware version a string like "MD_Downlink_Decoder_R2_070205" is send at power up.

Block Description

All data is send in comma delimited, line terminated (CR + LF) ASCII format.

Every block starts with a number sign "#", followed by the block number and block depending data. The last value is a checksum of all transmitted data.

The block number "0" is a marker for one of two possible errors:

"#0,0,36" transmission error in downlink data.

"#0,1,35" timeout error (no valid downlink data for more than 125ms).

The checksum is calculated over the line including the last comma - excluding the transmitted checksum (always the last transmitted value). The checksum must be an 8-bit variable (unsigned char) and set to zero before calculating a line. Then the ASCII value of every character is added to the checksum. Finally the checksum is the two's complement of this accumulated checksum (checksum = ~checksum).

In all lines only following characters are used: "#,.-0123456789".

Block 1 (Machine)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>	<i>COMMENT</i>
Firmware version	U08	10	99	BCD encoded 25 = ver 2.5
Serial number	U16	00001	65535	
Navigation mode	U08	1	3	0=INS only, 1=Mag / INS, 2=GPS / INS 3=Waypoint
GPS available	U08	0	1	0=not available, 1=available
Magnetometer available	U08	0	1	0=not available, 1=available
Baro altimeter available	U08	0	1	0=not available, 1=available
Battery voltage (mV)	U16	10000	16800	
Machine errors	U16	0	65535	

Example: “#1,17,104,2,1,1,1,0,14795,087”

Block: 1, Firmware: 1.7, Serial number: 00104, Navigation mode: 2 = GPS_INS, GPS available: 1 = available, Magnetometer available: 1 = available, Baro altimeter: 1 = available, Battery voltage: 14795mV, Machine errors: 0, Checksum: 87

Block 2 (RC values)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
RC Throttle	S08	-100	100
RC Pitch	S08	-100	100
RC Roll	S08	-100	100
RC Yaw	S08	-100	100
RC Aux1	S08	-100	100
RC Aux2	S08	-100	100
RC S1	S08	-100	100
RC S2	S08	-100	100
RC S3	S08	-100	100
RC Alternate throttle	S08	-100	100
RC Alternate pitch	S08	-100	100
RC Alternate roll	S08	-100	100
RC Alternate yaw	S08	-100	100
Receiver quality (%)	U08	0	100

Example: “#2,1,1,0,0,-100,-100,1,-100,-100,50,50,50,50,100,6”

Block: 2, Throttle: 1, Pitch: 1, Roll: 0, Yaw: 0, Aux1: -100, Aux2: -100, S1: 1, S2: -100, S3: -100, Alternate throttle: 50, Alternate pitch: 50, Alternate roll: 50, Alternate yaw: 50, Receiver quality: 100, Checksum: 6

Block 3 (Motors)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
Front motor	U08	0	255
Left motor	U08	0	255
Rear motor	U08	0	255
Right motor	U08	0	255

Example: “#3,39,31,42,39,43”

Block: 3, Front motor: 39, Left motor: 31, Rear motor: 42, Right motor: 39, Checksum: 43

Block 4 (Times)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>	<i>COMMENT</i>
Operating time (s)	U16	0	65535	Time since power up
GPS ITOW (ms)	U32	0	604800000	GPS time of week
GPS week	S16	0	32767	
Flight time (s)	U16	0	65535	

Example: “#4,34,131050499,1389,0,239”

Block: 4, Operating time: 34, GPS ITOW: 131050499, GPS week: 1389, Flight time: 0, Checksum: 239

Block 5 (GPS position ECEF)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
x (cm)	S32	-1000000000	+1000000000
y (cm)	S32	-1000000000	+1000000000
z (cm)	S32	-1000000000	+1000000000
Accuracy (m)	float	0.0	999999.0
Space vehicles used	U08	0	10

Example: “#5,414636551,61326129,479161556,3.239,5,240”

Block: 5, x: 414636551, y: 61326129, z: 479161556, Accuracy: 10.239, Space vehicles used: 5, Checksum: 240

Block 6 (GPS speed)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
North (m/s)	Float	-100.0	+100.0
East (m/s)	Float	-100.0	+100.0
Down (m/s)	Float	-100.0	+100.0
Accuracy (m/s)	Float	0.0	999999.0

Example: “#6,0.34,1.14,-0.22,1.32,143”

Block: 6, x: 0.34, y: 1.14, z: -0.22, Accuracy: 1.32, Checksum: 143

Block 7 (Attitude)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
Roll (rad)	float	$-\pi$	π
Pitch (rad)	float	$-\pi$	π
Yaw (rad)	float	$-\pi$	π

Example: “#7,1.52,-5.28,122.46,74”

Block: 7, r: 0.34, p: 1.14, y: -0.22, Checksum: 74

Block 8 (Altitude / Temperature)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>	<i>COMMENT</i>
Absolute height (m)	Float	-3000.0	0.0	negative height
Relative height (m)	Float	-1000.0	+1000.0	related to start
Temperature (°C/100)	S16	-32768	+32767	

Example: “#8,-326.22,12.73,21200,162”

Block: 8, a: -326.22, r: 12.73, t: 21200, Checksum: 162

Block 9 (Magnetometer)

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
Field x (μT)	float	-1000	+1000
Field y (μT)	float	-1000	+1000
Field z (μT)	float	-1000	+1000

Example: “#9,-34.55,12.83,28.52,51”

Block: 9, x: -34.55, y: 12.83, z: 28.52, Checksum: 51

Block 10 (Distance relative to POFF [point of first fix])

<i>FUNCTION</i>	<i>TYPE</i>	<i>MIN</i>	<i>MAX</i>
Distance North	float	-1000	+1000
Distance East	float	-1000	+1000
Distance Down	float	-1000	+1000

Example: “#10,28.21,14.06,47.52,242”

Block: 10, n: 28.14, e: 14.06, d: 47.52, Checksum: 242

Direct line calculation: distance = $\sqrt{n * n + e * e + d * d}$

For this example the distance is 56.99m