Graupner/HoTT

Technical Specification Document

HoTT SUMD Data Protocol

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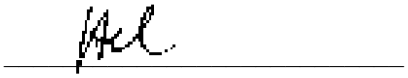
Approved By:	**Ralf Helbing**	

1 SPECIFICATION DETAIL

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2 CHANGE LOG

Date of Change	Version	Paragraph Changed	Summary of Changes	Editor
06/09/12	Rev 01 draft 1		Original document created	MH
06/12/12	Rev 01 draft 2		Harmonization	MH
06/12/12	Rev 01		Finalized Rev 01	MH

3 RELATED DOCUMENTS

- Graupner HoTT firmware documentation for HoTT receivers.
- Graupner HoTT transmitter and receiver user manuals

4 PURPOSE

This document describes the HoTT digital pulse train data protocol to support different application, e.g. Minicopters, Flybarless systems and battery power box systems. The data protocol is referred to as HoTT SUMD.

5 INTRODUCTION

HoTT SUMD is implemented by a 115200 bit/s serial data stream. The data stream is generated by HoTT receivers, e.g. #33505, #33506, #33508, #33512 and #33516. The transmitter generates a data frame at a data rate of 100Hz (10ms). Each data frame consists of a header followed by a data section representing the channel data and is concluded by a CRC checksum.

6 TIMING REQUIREMENTS

The serial connection needs to be set to 115200 Bit/s, 8 Databits, no Paritybit, 1 Stopbit. Each data frame is sent as a consistent data burst leaving minimal gaps less than 50µs between transmitted data bytes.

7 HOTT SUMD DATA STRUCTURE

A single SUMD data frame comprises of three consecutive sections. SUMD_Header, SUMD_Data, SUMD_CRC.

The SUMD_Data section contains the channel data in sequential order. The number of channels to be transmitted can be up to 32. Each channel data is represented by a 16 bit word. Note: the actual number of channels to be transmitted is a configurable receiver parameter. See related user manuals for further information.

SUMD_Header section description:

SUMD_Section	Byte_Number	Byte_Name	Byte_Value	Remark
SUMD_Header	Byte 0	Vendor_ID	0xA8	Graupner
SUMD_Header	Byte 1	Status	0x01	valid and live SUMD data frame
			0x81	valid SUMD data frame with transmitter in fail safe condition. Note: The SUMD_Data section contains valid channel data. The channel data are set by transmitter fail safe values. A FBL system may replace the transmitter fail safe data by FBL stored values
			other values	Values different to 0x01 or 0x81 indicate an invalid SUMD data frame and should not be processed by SUMD algorithms.
SUMD_Header	Byte 2	N_Channels	0x02..0x20	Indicates the number of channels transmitted in the SUMD_Data section

SUMD_Data section description:

SUMD_Section	Byte_Number	Byte_Name	Byte_Value	Remark
SUMD_Data	Byte n*2+1	Channel n High Byte	0x00..0xff	High Byte of channel n data. Note: n in {1.. N_Channels}
SUMD_Data	Byte n*2+2	Channel n Low Byte	0x00..0xff	Low Byte of channel n data Note: n in {1..N_Channels}

SUMD_CRC section description:

SUMD_Section	Byte_Number	Byte_Name	Byte_Value	Remark
SUMD_CRC	Byte (N_Channels+1)*2+1	CRC High Byte	0x00..0xff	High Byte of 16 Bit CRC
SUMD_CRC	Byte (N_Channels+1)*2+2	CRC Low Byte	0x00..0xff	Low Byte of 16 Bit CRC

8 CHANNEL DATA INTERPRETATION

Each channel data is represented by a unsigned 16 Bit Word. The data range is derived from the pulse length for standard servos. The servo position may be calculated by pulse_length = channel_data/8 with 1500µs for neutral position and 900µ/2100µs indicating the maximum end positions. Normalized stick position mapping table:

Stick Position	Channel Data	Remark
Extended low position (-150%)	0x1c20	Equivalent to 900µs pulse length
Low position (-100%)	0x2260	Equivalent to 1100µs pulse length
Neutral position (0%)	0x2ee0	Equivalent to 1500µs pulse length
High position (100%)	0x3b60	Equivalent to 1900µs pulse length
Extended high position (+150%)	0x41a0	Equivalent to 2100µs pulse length

9 CHANNEL MAPPING

The channels are transmitted in the following standard order for helicopters.

Channel Number	Function	Remark
1	Collective Pitch	
2	Aileron	
3	Elevator	
4	Yaw	
5		Note for MX-12 Transmitters: Aux/Gyro has to be mapped to channel 5 within the transmitter
6	ESC	
7	Aux/Gyr	Note for MX-12 Transmitters: Aux/Gyro has to be mapped to channel 5 within the transmitter

10 CRC CALCULATION

The CRC is calculated taking SUMD_Header and SUMD_DATA into account as is derived by the following algorithm.

```
#define CRC_POLYNOME 0x1021
/*****************************************************************************
* Function Name : CRC16
* Description : crc calculation, adds a 8 bit unsigned to 16 bit crc
*****************************************************************************/
u16 CRC16(u16 crc, u8 value)

{
  u8 i;

        crc = crc ^ (s16)value<<8;

        for(i=0; i<8; i++) {
          if (crc & 0x8000)
            crc = (crc << 1) ^ CRC_POLYNOME;
          else
            crc = (crc << 1);
        }

        return crc;
}
```

11 COMPATIBILITY

The HoTT SUMD protocol is an essential element within the Graupner HoTT system. Further technical enhancements may happen but the implementation of this HoTT SUMD specification will be maintained for downwards compatibility reasons.

Please note that some receivers like the #33565 and #33566 can not support HoTT SUMD according to this specification because of hardware restrictions These receivers are mainly designed for low range slow flyers and will implement a technically different version of the HoTT SUMD specification. This version will be clearly distinguishable by the SUMD_Header status byte. Further details will be released in a separate specification document. Third party applications may decide upon release of the future additional specification to support this protocol in addition to the HoTT SUMD protocol specified in this document.