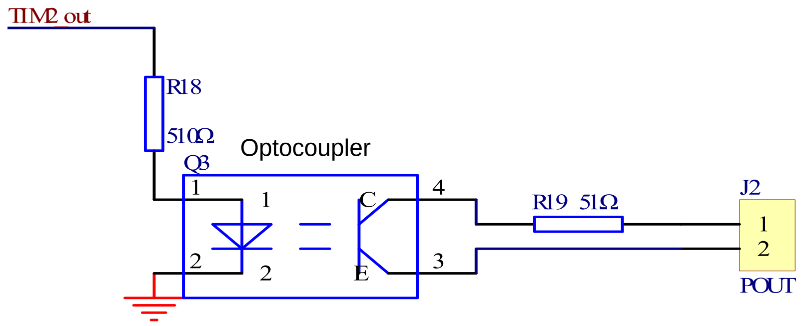
Frame Protocol of
FrSky Lipo Voltage Sensor and Ampere Sensor

1. Aim

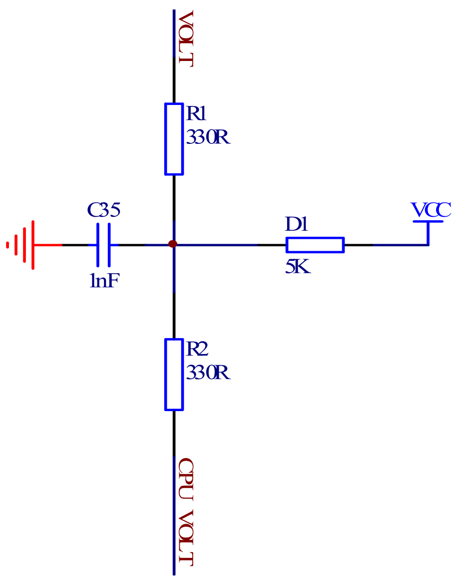
To help users develop their own programs and make full use of FrSky two-way telemetry systems.

2. Hardware definition

2.1 Sensor side



2.2 Hub side



3. Protocol

3.1 Byte-stuffing

3.1.1 Output:

Byte in frame has value 0x7E is changed into 2 bytes: 0x7D, 0x5E

Byte in frame has value 0x7D is changed into 2 bytes: 0x7D, 0x3D

3.1.2 Input:

When byte 0x7D is received, discard this byte, and the next byte is XORed with 0x20.

3.2 Frame

7E	Total Cell	ID	DL	DH	00	CRCL	CRCH	7E

- 7E: start
- Total Cell
- ID: data ID

For Ampere Sensor:
Ampere data ID: 0x28
Voltage data ID (integer part): 0x3A
Voltage data ID (decimal part): 0x3B
For Lipo Voltage Sensor:
Lipo Voltage data ID: 0x06

- DL: low byte
- DH: high byte
- 00: reserved byte
- CRCL
- CRCH
- 7E: end

3.3 Data format of DL & DH

3.3.1 Data format for lipo voltage sensor

The first 4 bit refers to the cell number, while the last 12 bit refers to the lipo voltage data, 0~2100 corresponding to 0~4.2V.

3.3.2 Data format for ampere sensor

Integer and decimal parts of voltage are transmitted with different data ID.

3.4 Protocol of data transform

The value of hexadecimal code for each byte multiplied by 8 (error tolerance of 4us) and plus 5000, with unit of us, is transformed into rectangular wave of corresponding period.

4. Notes

4.1 CRC: see ① below.

4.2 FrSky Lipo Voltage Sensor and Ampere Sensor share the same hub connector, users can connect one of them to detect either voltage for each cell or ampere, or combine both of them to detect both voltage for each cell and ampere.

```
①//CRC
uint16_t FcsCheck(uint8_t *pdata,short num)
{
   uint16_t FCS;
   int i;
   FCS=0x0;
   for(i=0;i<num;i++){
      FCS=(FCS>>8)^CRCTable[(FCS^pdata[i]) & 0xFF];
   }
   return FCS;
}

//CRC TABLE
unsigned int CRCTable[]=
{
0x0000,0x1189,0x2312,0x329b,0x4624,0x57ad,0x6536,0x74bf,0x8c48,0x9dc1,0xaf5a,0x
bed3,0xca6c,0xdbe5,0xe97e,0xf8f7,0x1081,0x0108,0x3393,0x221a,0x56a5,0x472c,0x75
b7,0x643e,0x9cc9,0x8d40,0xbfdb,0xae52,0xdaed,0xcb64,0xf9ff,0xe876,0x2102,0x308b,
0x0210,0x1399,0x6726,0x76af,0x4434,0x55bd,0xad4a,0xbcc3,0x8e58,0x9fd1,0xeb6e,0x
fae7,0xc87c,0xd9f5,0x3183,0x200a,0x1291,0x0318,0x77a7,0x662e,0x54b5,0x453c,0xbd
cb,0xac42,0x9ed9,0x8f50,0xfbef,0xea66,0xd8fd,0xc974,0x4204,0x538d,0x6116,0x709f,0
x0420,0x15a9,0x2732,0x36bb,0xce4c,0xdfc5,0xed5e,0xfcd7,0x8868,0x99e1,0xab7a,0xb
af3,0x5285,0x430c,0x7197,0x601e,0x14a1,0x0528,0x37b3,0x263a,0xdecd,0xcf44,0xfddf
,0xec56,0x98e9,0x8960,0xbbfb,0xaa72,0x6306,0x728f,0x4014,0x519d,0x2522,0x34ab,0
x0630,0x17b9,0xef4e,0xfec7,0xcc5c,0xddd5,0xa96a,0xb8e3,0x8a78,0x9bf1,0x7387,0x6
20e,0x5095,0x411c,0x35a3,0x242a,0x16b1,0x0738,0xffcf,0xee46,0xdcdd,0xcd54,0xb9e
b,0xa862,0x9af9,0x8b70,0x8408,0x9581,0xa71a,0xb693,0xc22c,0xd3a5,0xe13e,0xf0b7,
0x0840,0x19c9,0x2b52,0x3adb,0x4e64,0x5fed,0x6d76,0x7cff,0x9489,0x8500,0xb79b,0x
a612,0xd2ad,0xc324,0xf1bf,0xe036,0x18c1,0x0948,0x3bd3,0x2a5a,0x5ee5,0x4f6c,0x7df
7,0x6c7e,0xa50a,0xb483,0x8618,0x9791,0xe32e,0xf2a7,0xc03c,0xd1b5,0x2942,0x38cb,
0x0a50,0x1bd9,0x6f66,0x7eef,0x4c74,0x5dfd,0xb58b,0xa402,0x9699,0x8710,0xf3af,0xe
226,0xd0bd,0xc134,0x39c3,0x284a,0x1ad1,0x0b58,0x7fe7,0x6e6e,0x5cf5,0x4d7c,0xc60
c,0xd785,0xe51e,0xf497,0x8028,0x91a1,0xa33a,0xb2b3,0x4a44,0x5bcd,0x6956,0x78df,
0x0c60,0x1de9,0x2f72,0x3efb,0xd68d,0xc704,0xf59f,0xe416,0x90a9,0x8120,0xb3bb,0xa
232,0x5ac5,0x4b4c,0x79d7,0x685e,0x1ce1,0x0d68,0x3ff3,0x2e7a,0xe70e,0xf687,0xc41
c,0xd595,0xa12a,0xb0a3,0x8238,0x93b1,0x6b46,0x7acf,0x4854,0x59dd,0x2d62,0x3ceb,
0x0e70,0x1ff9,0xf78f,0xe606,0xd49d,0xc514,0xb1ab,0xa022,0x92b9,0x8330,0x7bc7,0x6
a4e,0x58d5,0x495c,0x3de3,0x2c6a,0x1ef1,0x0f78
};
```