RS232 Protocol for Communication with the *Microray Series* Board

General RS232 Parameters
Rate: 9600 bds
No parity
Data bits: 8
Stop bits: 1
No input/output HW Handshake
No input/output XON/XOFF
No input/output alt HW HShk

The processor of the *Microray* Board is compatible with MCS-51 products.

The *Microray* Board starts putting out data as soon as it is switched on. A reset of the *Microray* Board is not possible through the PC software but is only possible with the Reset Button situated on the board.

Each communication starts with a byte, which defines the action (start byte), then the data follows (if the action requires data) and finishes with a stop byte.

Byte	MSB							LSB	Description
1	0	0	X	X	X	X	X	X	Start Byte (action identifyer)
2..n-1	1	X	X	X	X	X	X	X	Data
n	0	1	X	X	X	X	X	X	Stop Byte

MSB = Most Significant Bit
LSB = Least Significant Bit

The MSB bit identifies if the byte is an action or data (0 for an action and 1 for data). The MSB-1 bit of an action byte defines whether it is a start or stop byte (0 for a start byte and 1 for a stop byte). The other 6 bits are the action identifier, which gives up to 64 different actions.
The action identifiers are the same for the stop and start bytes.
Each data byte sends 7 bits of data.

Presently, two transmissions are defined:

Transmission PC -> Interface module: Phase shift for Mult signal (Action :0x00010)

Data Name: PSFT
Data lenght: 13 bits (0 to 12)

Bits 7-12 are sent with the first data byte and the bits 0-6 with the second data byte. The entire transmission sequence is then:

	MSB							LSB	Hexa
Byte 1	0	0	1	1	0	0	0	0	30H
Byte 2	1	0	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	XXH
Byte 3	1	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	XXH
Byte 4	0	1	1	1	0	0	0	0	70H

Operation of the Phase Shifter

The phase shifter must shift the phase with a resolution of better than 0.1° of the digital MULT signal. The latter has a frequency of 10 Hz and is connected to the BNC connector of the *Microray* Board. The basic idea is to load a word (DATA) into a counter at each edge of the MULT signal and to increment the counter with a clock signal which has a frequency much higher than MULT. When the counter overflows, the phase shifted MULT output signal is inverted. The clock signal of the counter is the master clock of the readout module operating at 81.92 kHz. Considering a half period of MULT, i.e. 50ms, the resolution is given by:

$$\Delta\varphi = \frac{12.2\mu}{50m} \cdot 180 = 0.044°$$

It means that the value of the phase change in degree is to divide by 0.044. The DATA must be 12 bits wide plus a sign bit (shift of 180°). Note that in order to have a continuous phase shift, the complementary DATA must be loaded to allow for a negative phase phase shift
Normally, the command to set the phase occurs before receiving the first data, but it is possible to modify at any time.

Example:

Let set a value x for the phase shift:

If x >=0: value = [(x-180)* (-1)]/ (0,0439453125)

If x <0: value = [x* (-1)]/ (0,0439453125)

After this, take the positiv integer value and send to the *Microray* Board as follow (if value is positiv, bit 12 =0, if value is negativ, bit 12 = 1):

Lets have a value of phase shift from 48°.
The positiv integer value to send is 3004. In binaire, the value is 0101110111100. The 4 Bytes to send are:

Byte 1: 30H
Byte 2: 97H

Byte 3 : BCH
Byte 4: 70H

Transmission Interface module -> PC: send 64 channel data

Data Name CHX (with X=1 to 64)
Data lenght 13 bits (0 to 12)
The data of the channel 1 is first sent to the PC. A channel data uses two bytes where bits 7-12 are sent with the first data bytes and the bits 0-6 with the second data byte. The entire transmission sequence is then:

	MSB							LSB	Hexa
Byte 1	0	0	1	0	0	0	1	1	23H
Data pixel 1									
Byte 2	1	0	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	XXH
Byte 3	1	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	XXH
Data pixel i									
Byte 2i	1	0	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	XXH
Byte 2i+1	1	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	XXH
...									
...									
Data pixel 64									
Byte 128	1	0	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	XXH
Byte 129	1	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	XXH
Byte 130	0	1	1	0	0	0	0	0	60H

Note : when using an *Microray* Board with a 16- or 32-pixels sensor, just treat the values as using a 64-pixels sensor but ignore the values from 17 (or 33) to 64.