Firmware / INCR3

The /INCR3 firmware can decode positions of three incremental encoders (TTL level). The encoder signals (A; B) are counted with 32 bit (position) counters. A falling edge at input A is the clock for the counter. Counter direction is depending on the status of B input. (high = up / low = down). Each of three input channels is equipped with an ENABLE input.
Maximum count rate is approx 20 kHz (ratio 1:1).
A index signal Z can be used, if available from the encoder. A falling edge on input Z will reset the position counter to zero, so the position counter is synchronized with the Z index. In addition the Z signal is the clock for a 16 bit (cycle) counter. The cycle count direction taken from the position counter direction.

The encoder signals are connected to port B and port C as follows:

Encoder 1

Port C0	Input	1A	CLK
Port C1	Input	1B	DIR
Port B0	Input	1Z	/RES
Port B3	Input	1EN	EN

Encoder 2

Port C2	Input	2A	CLK
Port C3	Input	2B	DIR
Port B1	Input	2Z	/RES
Port B4	Input	2EN	EN

Encoder 3

Port C4	Input	3A	CLK
Port C5	Input	3B	DIR
Port B2	Input	3Z	/RES
Port B5	Input	3EN	EN (remove Jumper J4 LED!)

All inputs use TTL level (5V) and are bound to Vcc with internal pull-up resistors.

Port D is a general purpose digital I/O port, with programmable direction for each line.
Line D6 delvers a clock signal if set to output. The base clock frequency is 9 kHz which can be devided through 1,2,3,….,256. A pull-up can be activated for each input line of port D.

The device gets programmed with commands, send out with the request data block of data protocol.

Protocol description

Baud 57600
8 data bits
No Parity
1 stop bit

Request / Response communication is used. A request consists of 5 data bytes. After receiving 5 bytes, the device responses with a 21 bytes long response data block
A sample rate of approx. 150 samples/sec can be achieved.

Request: 5 Bytes

Byte 1: Command
Byte 2…5: Parameter

The command (Byte1) contains a function number, that cause some certain device actions. Undefined function numbers are answered with an resonse block as well, but do not cause any further action. A parameter (Byte2…Byte4) must be sent in any case, even if it is only recognised with some of the commands. The four bytes of the parameter are interpreted as a value of 32 bits, 16 bits or 8 bits, where Byte 2 is least significant and Byte 5 is most significant.

The following commands can be sent out as a request block:

Decimal	HEX	CHR	Description	Parameter
Counter commands:				
65dez	41h	„A“	Reset Counter 0	don´t care
66dez	42h	„B“	Reset Counter 1	don´t care
67dez	43h	„C“	Reset Counter 2	don´t care
68dez	44h	„D“	Reset Z-Counter 0	don´t care
69dez	45h	„E“	Reset Z-Counter 1	don´t care
70dez	46h	„F“	Reset Z-Counter 2	don´t care
71dez	47h	„G“	Load Counter 0	INT32 / DWORD
72dez	48h	„H“	Load Counter 1	INT32 / DWORD
73dez	49h	„I“	Load Counter 2	INT32 / DWORD
74dez	4Ah	„J“	Load Z-Counter 0	INT16 / WORD
75dez	4Bh	„K“	Load Z-Counter 1	INT16 / WORD
76dez	4Ch	„L“	Load Z-Counter 2	INT16 / WORD
Port D commands				
88dez	58h	„X“	Clock devisor f=9 KHz / (N+1)	Byte
89dez	59h	„Y“	PORTD = Status / Pull-up	Byte
90dez	5Ah	„Z“	DDRD = Data direction	Byte

Request example Byte1…Byte 5: <5A><FC><00><00><00>
<5A> = Command „Data direction Port D“
<FC> = %1111 1100 = Bit2…Bit7 SET = D2…D7 Direction set to OUTPUT

After receiving the five request bytes, the device will send a response. Do not send a new request before having received the response.

Response: 21 Bytes

Port status:

Byte1:	Status Port B	Bit 0..5 = B0..B5
Byte2:	Status Port C	Bit 0..5 = C0..C5
Byte3:	Status Port D	Bit 2..7 = D2..D7

Position counters:

Byte4:	Counter 1	Bit 0…7 (LSB)
Byte5:	Counter 1	Bit 8…15
Byte6:	Counter 1	Bit 16…23
Byte7:	Counter 1	Bit 24…32 (MSB)
Byte8:	Counter 2	Bit 0…7 (LSB)
Byte9:	Counter 2	Bit 8…15
Byte10:	Counter 2	Bit 16…23
Byte11:	Counter 2	Bit 24…32 (MSB)
Byte12:	Counter 3	Bit 0…7 (LSB)
Byte13:	Counter 3	Bit 8…15
Byte14:	Counter 3	Bit 16…23
Byte15:	Counter 3	Bit 24…32 (MSB)

Cycle counters (Z):

Byte16:	Counter 1	Bit 8…15 (LSB)
Byte17:	Counter 1	Bit 0…7 (MSB)
Byte18:	Counter 2	Bit 8…15 (LSB)
Byte19:	Counter 2	Bit 0…7 (MSB)
Byte20:	Counter 3	Bit 8…15 (LSB)
Byte21:	Counter 3	Bit 0…7 (MSB)

Bytes 1…3 deliver the digital line status. A SET bit indicates a HIGH level. This is independent from the lines direction.

Bytes 4..15 contain the 32 bits counter values (position).
Bytes 16…21 contain the 16 bits counter values (cycles; Z)