



Control eHouse BMS system by MODBUS TCP protocol

Rev. 0.1beta

Settings eHouse PRO For Modbus TCP SERVER Stored in /usr/local/e-house/modbus.cfg				
Line: NR	Function	value on	value off	Description
1	ModbusEnabled	1	0	Modbus Server Enable
2	Modbus PORT	502	0..2000	TCP/IP Socket PORT
3	Modbus AutoDisconnect	30		Inactivity Disconnect [s] – 0 immediately
4	Modbus Autorization Type	3	0..4	Future: autorization function (enabling write to registry)
5	Vendor Code	„000000000“		Future: Used for changing authorization algorithm
6	Modbus Password	aBBrACaDaBRA		Future: Used for autorisation type
7	Modbus TCP Socket Timeout	120		TCP/IP Socket configuration disconnect
8	Modbus Server Debug	1	0	Display Debug information on screen
9	Modbus Hashing Code	„109381098301923“		Future: Hashing value for decoding authorization
10	TCP Socket No Delay	1	0	TCP/IP Socket No Delay (Nagle)
11	TCP Socket Keep Alive	1	0	Keep Alive option for TCP/IP Socket Connection

RW – Coils – Binary Outputs (ON/OFF) and other signals which can be readable/writable

R Coils – Binary Inputs (on/off) – Read only signals

RW Registers – values (0..0xffff) which can be readable/writable (ADC Levels, Dimmers, Programs, Events Queue)

R Registers – values (0..0xffff) which are read only (ADC Measurements, Statuses, etc)

Maximal 5 Server connection is available

INFO: <http://isys.pl/><http://smart.ehouse.pro/>DIY: <http://idom.ehouse.pro/>EN Shop: <http://ehouse.biz/>PL Shop: <http://ehouse.net.pl/>

RW Coils - Outputs



eHouse PRO Binary Outputs/OFFSET	0	1	2	3	4	5	6	7	8	9	0xA	0xB	0xC	0xD	0xE	0xF
0 BASE Address Ehouse PRO 1..128	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x10	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0x20	33															
0x30																
0x40																
0x50																
0x60																
0x70																
0x80 eHouse PRO optional (129..256)																
0x90																
0xa0																
0xb0																
0xc0																
0xd0																
0xf0																
0x100																
0x110																
0x120																
0x130																
0x140																
0x150																
0x160																
0x170																
0x180																
0x190																
0x1a0																
0x1b0																
0x1c0																
0x1d0																
0x1f0																
0x200 eHouse LAN – CM 1..88	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x210	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0x220	RW Coils Address assignment X-0x200 => 0x+1 (CM - eHouse LAN)															
0x230																
0x240																
0x250																
0x260																
0x270																
0x280																
0x290																
0x2a0																
0x2b0																
0x2c0																
0x2d0																
0x2f0																
0x300 Future Use Controller	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x310																
0x320																
0x330																
0x340																
0x350																
0x360																
0x370																
0x380																
0x390																
0x3a0																
0x3b0																
0x3c0																
0x3d0																
0x3e0																
0x3f0																

RW Coils - Outputs

Other controllers Outputs WiFi, LAN, RS-485, CAN, RF, LORA																/ 128 – Division 128		% 128 – Modulo 128		
0x400	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=0 => EHM	Controller Index Address n= (X-0x400)/128	LANn	
0x410	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128		
0x420	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8	N=0 => HM	Output Index o=(X-40)%128		
0x430 – RS-485 (HM)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
0x440	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485			
0x450 – CAN0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128		
0x460 – CAN/RF0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128		
0x470 – WIFI	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA			
0x480 – ERM1 => N=1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=1 => ERM1	Controller Index Address n= (X-0x400)/128	LANn	
0x490	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128		
0x4a0	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8	N=1 => RM1	Output Index o=(X-40)%128	Rsn	
0x4b0 – RS-485 (RM1)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
0x4c0	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485			
0x4d0 – CAN1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128		
0x4e0 – CAN/RF1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128		
0x4f0 – WIFI1	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA			
0x500 – ERM2 => N=2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=2	Controller Index Address n= (X-0x400)/128	LANn	
0x510	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128		
0x520	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Output Index o=(X-40)%128	Rsn	
0x530 – RS-485 (RM2)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
0x540	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485			
0x550 – CAN2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128		
0x560 – CAN/RF2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128		
0x570 – WIFI	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA			
0x580 – ERM3 => N=3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=3	Controller Index Address n= (X-0x400)/128	LANn	
0x590	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128		
0x5a0	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Output Index o=(X-40)%128	Rsn	
0x5b0 – RS-485 (RM3)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
0x5c0	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485			
0x5d0 – CAN3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128		
0x5e0 – CAN/RF3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128		
0x5f0 – WIFI3	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA			



0x8100 – ERM250 => N=250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=250	Controller Index Address n= (X-0x400)/128	LANn
0x8110	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128	
0x8120	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Output Index o=(X-40)%128	Rsn
0x8130 – RS-485 (RM250)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
0x8140	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485		
0x8150 – CAN250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128	
0x8160 – CAN/RF250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128	
0x8170 – WIFI250	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA		
0x8180 – ERM251 => N=251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=251	Controller Index Address n= (X-0x400)/128	LANn
0x8190	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Output Index o=X%128	
0x81a0	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Output Index o=(X-40)%128	Rsn
0x81b0 – RS-485 (RM251)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
0x81c0	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485		
0x81d0 – CAN251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Output Index o=(X-80)%128	
0x81e0 – CAN/RF251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Output Index o=(X-96)%128	
0x81f0 – WIFI251	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA		



0x8100 – ERM250 => N=250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=250	Controller Index Address n= (X-0x400)/128	LANn
0x8110	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Input Index i=X%128	
0x8120	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Input Index i=(X-40)%128	Rsn
0x8130 – RS-485 (RM250)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
0x8140	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485		
0x8150 – CAN250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Input Index i=(X-80)%128	
0x8160 – CAN/RF250	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Input Index i=(X-96)%128	
0x8170 – WIFI250	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA		
0x8180 – ERM251 => N=251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	N=251	Controller Index Address n= (X-0x400)/128	LANn
0x8190	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	LAN	Input Index i=X%128	
0x81a0	33	34	35	36	37	38	39	40	1	2	3	4	5	6	7	8		Input Index i=(X-40)%128	Rsn
0x81b0 – RS-485 (RM251)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
0x81c0	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	RS-485		
0x81d0 – CAN251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN	Input Index i=(X-80)%128	
0x81e0 – CAN/RF251	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	CAN/RF	Input Index i=(X-96)%128	
0x81f0 – WIFI251	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	LORA		

0x9000 – PRO Inputs in Warning State	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	33															

ACTIVE WARNING STATE INPUTS

R Coils Address assignment X => lx+1 (eHouse PRO)

0x9100 – PRO Inputs in Silent State	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	33															

ACTIVE SILENT ALARM STATE INPUTS

R Coils Address assignment X => lx+1 (eHouse PRO)

0x9200 – PRO Inputs in Silent State	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	33															

ACTIVE MONITORING STATE INPUTS

R Coils Address assignment X => lx+1 (eHouse PRO)

	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256
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RW Registers

Read/Write Registers /OFFSET	0	1	2	3	4	5	6	7	8	9	0xA	0xB	0xC	0xD	0xE	0xF	
0 BASE Address																	
eHouse PRO ADC LOW THRESHOLD 1..128	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Absolute Values
0x10	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	
0x20	33																
0x30																	
0x40	RW Registry Address assignment X => ADCLx+1 (eHouse PRO)																
0x50																	
0x60																	
0x70	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	
0x80 eHouse PRO ADC HIGH THRESHOLD (1..128)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Absolute Values
0x90																	
0xA0																	
0xB0																	
0xC0																	
0xD0	RW Registry Address assignment X => ADCHx+1 (eHouse PRO)																
0xE0																	
0xF0	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	
0x100 eHouse PRO DIMMERS LEVELS (1..128)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Absolute Values
0x110																	
0x120																	
0x130																	
0x140																	
0x150																	
0x160																	
0x170	RW Registry Address assignment X => DIMx+1 (eHouse PRO)																
0x180 - Execution Queue	EV1[0]	EV1[1]	EV1[2]	EV1[3]	EV1[4]	EV1[5]	EV1[6]	EV1[7]	EV1[8]	EV1[9]							
0x190																	
0x1A0																	
0x1B0																	
0x1C0	Execution eHouse Direct Events Queue (22 Events) 220 bytes																
0x1D0																	
0x1F0																	
0x200																	
0x210																	
0x220																	
0x230																	
0x240																	
0x250																	

BMS
eHouse

RW Registers

Controller Index Address N= (X-0x400)256	Registry Index o=X%256															
0x400 eHouse LAN – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x410 eHouse LAN – ADC HIGH THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x420 eHouse LAN – PROGRAMS TYPES	PRG	ZONE	ADC-PRG													
0x430 eHouse LAN – DIMMERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x440																
0x450																
0x460																
0x470																
0x480 eHouse RS485 – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x490 eHouse RS485 – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x4a0 eHouse RS485 – PROGRAM TYPES	PRG															
0x4b0 eHouse RS485 – DIMMERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x4c0 eHouse CAN – ADC LOW THRESHOLDS 1..4																
0x4c4 eHouse CAN – ADC HIGH THRESHOLDS 1..4																
0x4c8 eHouse CAN – DIMMERS 1..4																
0x4cc eHouse CAN – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x4d0 eHouse CANRF – ADC LOW THRESHOLDS 1..4																
0x4d4 eHouse CANRF – ADC HIGH THRESHOLDS 1..4																
0x4d8 eHouse CANRF – DIMMERS 1..4																
0x4dc eHouse CANRF – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x4e0 eHouse WIFI – ADC LOW THRESHOLDS 1..4																
0x4e4 eHouse WIFI – ADC HIGH THRESHOLDS 1..4																
0x4e8 eHouse WIFI – DIMMERS 1..4																
0x4ec eHouse WIFI – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x4f0 eHouse LORA – ADC LOW THRESHOLDS 1..4																
0x4f4 eHouse LORA – ADC HIGH THRESHOLDS 1..4																
0x4f8 eHouse LORA – DIMMERS 1..4																
0x4fc eHouse LORA – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
0x500 eHouse LAN – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x510 eHouse LAN – ADC HIGH THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x520 eHouse LAN – PROGRAMS TYPES	PRG	ZONE	ADCPRG													
0x530 eHouse LAN – DIMMERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x540																
0x550																
0x560																
0x570																
0x580 eHouse RS485 – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x590 eHouse RS485 – ADC LOW THRESHOLD 1..16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x5a0 eHouse RS485 – PROGRAM TYPES	PRG															
0x5b0 eHouse RS485 – DIMMERS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0x5c0 eHouse CAN – ADC LOW THRESHOLDS 1..4																
0x5c4 eHouse CAN – ADC HIGH THRESHOLDS 1..4																
0x5c8 eHouse CAN – DIMMERS 1..4																
0x5cc eHouse CAN – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x5d0 eHouse CANRF – ADC LOW THRESHOLDS 1..4																
0x5d4 eHouse CANRF – ADC HIGH THRESHOLDS 1..4																
0x5d8 eHouse CANRF – DIMMERS 1..4																
0x5dc eHouse CANRF – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x5e0 eHouse WIFI – ADC LOW THRESHOLDS 1..4																
0x5e4 eHouse WIFI – ADC HIGH THRESHOLDS 1..4																
0x5e8 eHouse WIFI – DIMMERS 1..4																
0x5ec eHouse WIFI – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8
0x5f0 eHouse LORA – ADC LOW THRESHOLDS 1..4																
0x5f4 eHouse LORA – ADC HIGH THRESHOLDS 1..4																
0x5f8 eHouse LORA – DIMMERS 1..4																
0x5fc eHouse LORA – MORE DTA	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

0..0xffff N=0


0..0xffff N=1

R Registers

Read/Write Registers /OFFSET
 0 BASE Address
 eHouse PRO ADC Measurements 1..128
 0x10
 0x20
 0x30
 0x40
 0x50
 0x60
 0x70
 0x80 eHouse PRO MORE (1..128)
 0x90
 0xa0
 0xb0
 0xc0
 0xd0
 0xe0
 0xf0
 0x100 eHouse PRO Future
 0x110
 0x120
 0x130
 0x140
 0x150
 0x160
 0x170
 0x180
 0x190
 0x1a0
 0x1b0
 0x1c0
 0x1d0
 0x1f0

0	1	2	3	4	5	6	7	8	9	0xA	0xB	0xC	0xD	0xE	0xF
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33															
RW Registry Address assignment X => ADCLx+1 (eHouse PRO)															
113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
RW Registry Address assignment X => ADCHx+1 (eHouse PRO)															
113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128

Absolute Values

Absolute Values



0x200 eHouse LAN – ADC Measurement 1..16
 0x210 eHouse LAN – Status 112 B
 0x220
 0x230
 0x240
 0x250
 0x260
 0x270
 0x280 eHouse RS485 – ADC Measurement 1..16
 0x290 eHouse RS485 – Status
 0x2a0
 0x2b0
 0x2c0 eHouse CAN – ADC Measurements 1..4
 0x2c4 Status
 0x2d0 eHouse CANRF – Measurements 1..4
 0x2d4 – Status
 0x2e0 eHouse WiFi – ADC Measurements 1..4
 0x2e4 Status
 0x2f0 eHouse LORA – ADC Measurements 1..4
 0x2f4 eHouse LORA – Status
 0x300 eHouse LAN – ADC Measurement 1..16
 0x310 eHouse LAN – Status 112 B
 0x320
 0x330
 0x340
 0x350
 0x360
 0x370
 0x380 eHouse RS485 – ADC Measurement 1..16
 0x390 eHouse RS485 – Status
 0x3a0
 0x3b0
 0x3c0 eHouse CAN – ADC Measurements 1..4
 0x3c4 Status
 0x3d0 eHouse CANRF – Measurements 1..4
 0x3d4 – Status
 0x3e0 eHouse WiFi – ADC Measurements 1..4
 0x3e4 Status
 0x3f0 eHouse LORA – ADC Measurements 1..4
 0x3f4 eHouse LORA – Status

Controller Index Address n= (X-0x200)/256	Registry Index o=X%256															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1Byte=>1Word																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1Byte=>1Word																
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1Byte=>1Word																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1Byte=>1Word																
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	
1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	

N=0

N=1