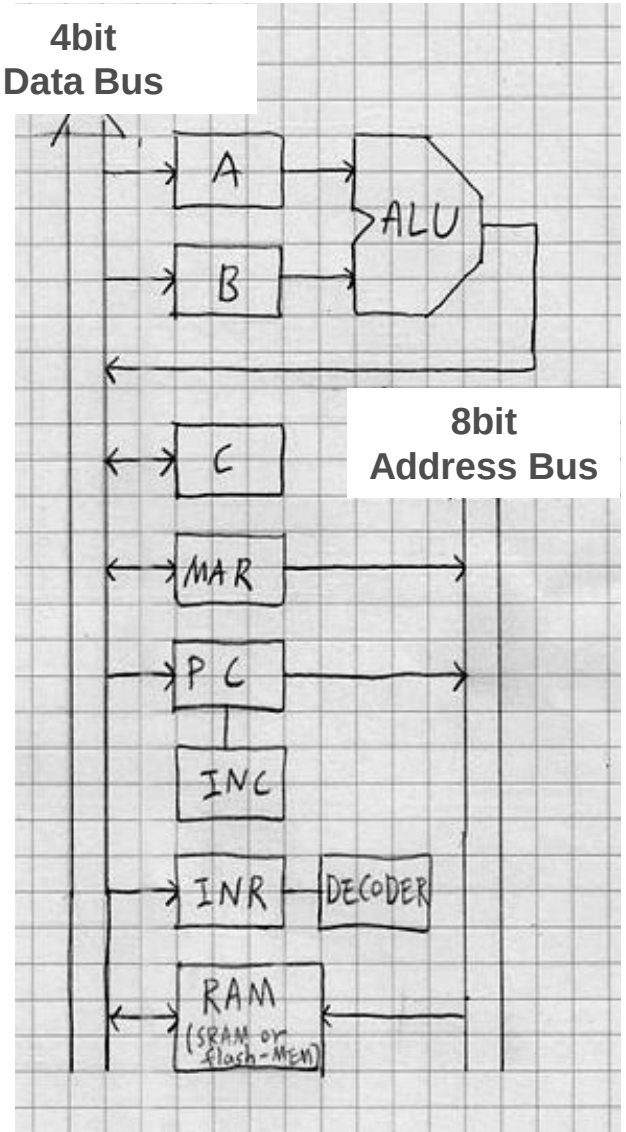
4-Bit Relay Computer

20142022 권기용

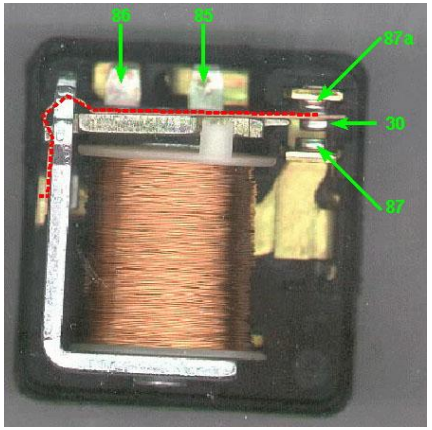
전체 구성

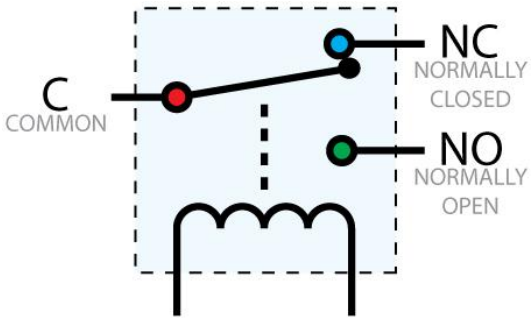
- 3개 레지스터
- 7가지 연산기능 ALU
- Program Counter
- Instruction 레지스터(INR)
- 명령어 해독기(Decoder)
- 메모리 주소 레지스터(MAR)
- ROM

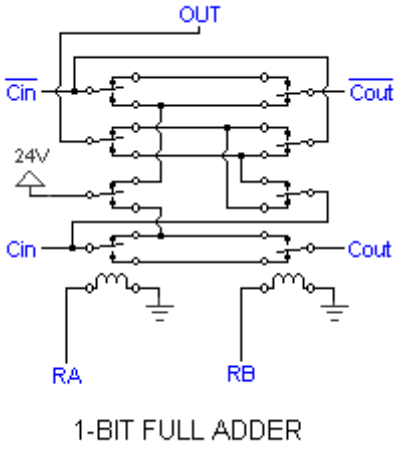


Relay(릴레이)

- 전자석에 전류를 흘려줌으로써 스위치 역할을 하는 소자
- 트랜지스터의 스위칭 기능을 구현 가능







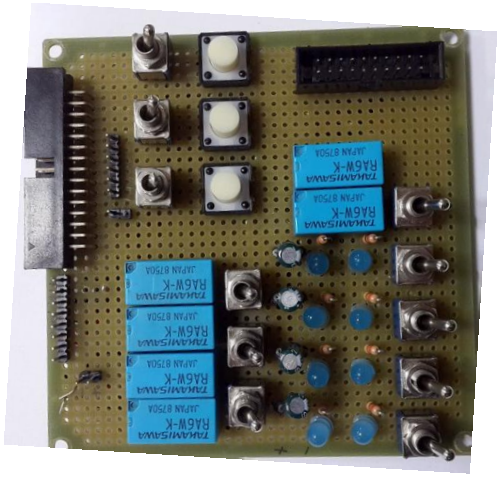
1-BIT FULL ADDER

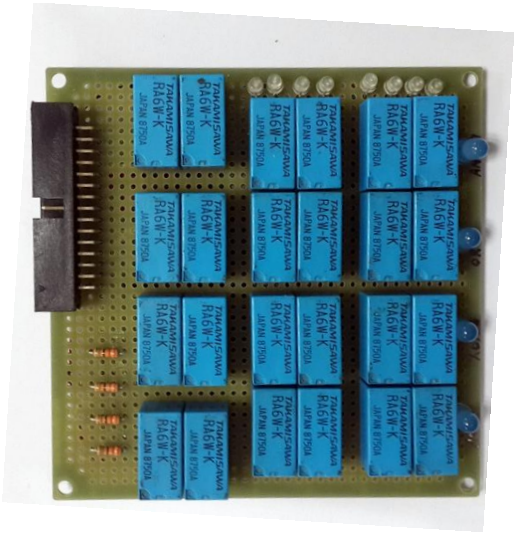
ALU & Register

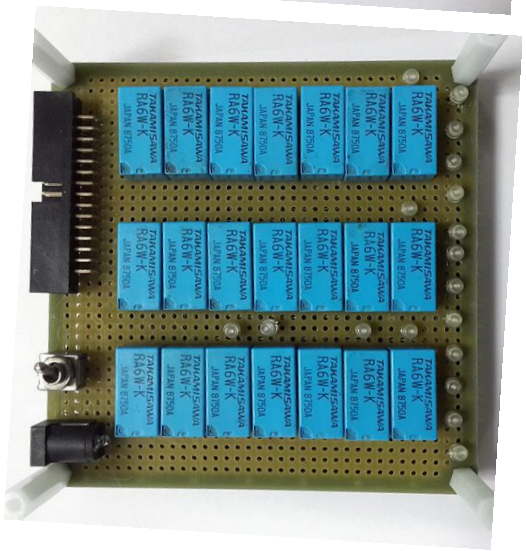
- ADD, AND, OR, XOR, NOT 5가지 논리연산
- Increaser(INC): +1, MSB Carry Out 표시 됨
- Left Shift 1Bit(LST): circulating, non-circulating 선택가능

- Register A,B 는 ALU 입력에 직결
- Register C는 범용 레지스터로 사용

ALU & Register

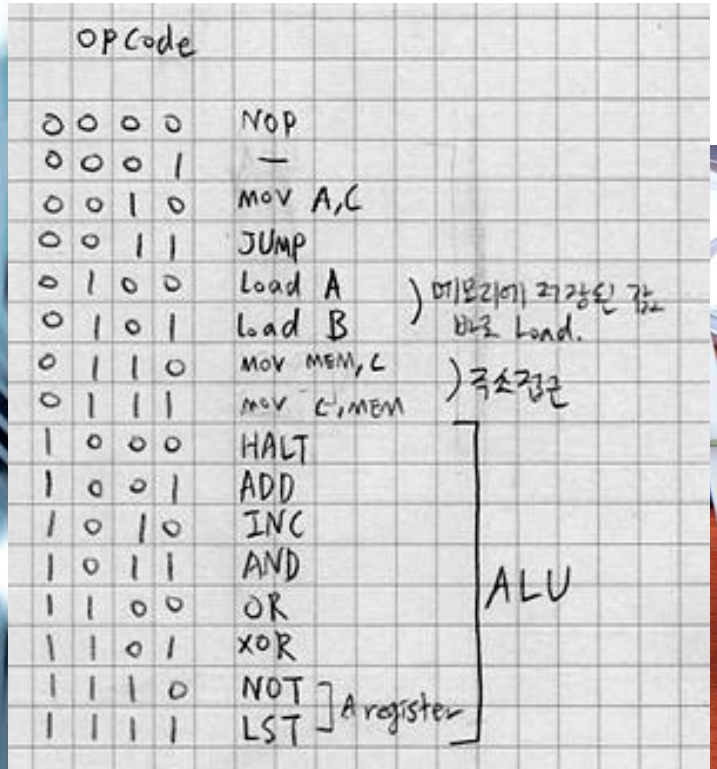




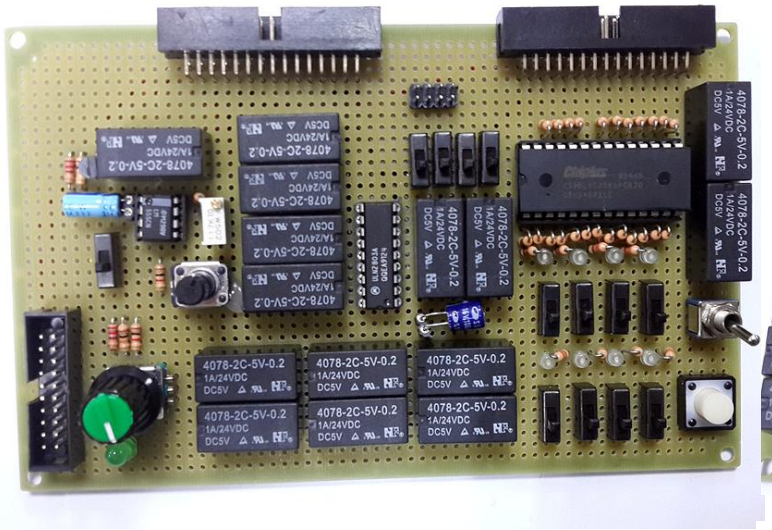


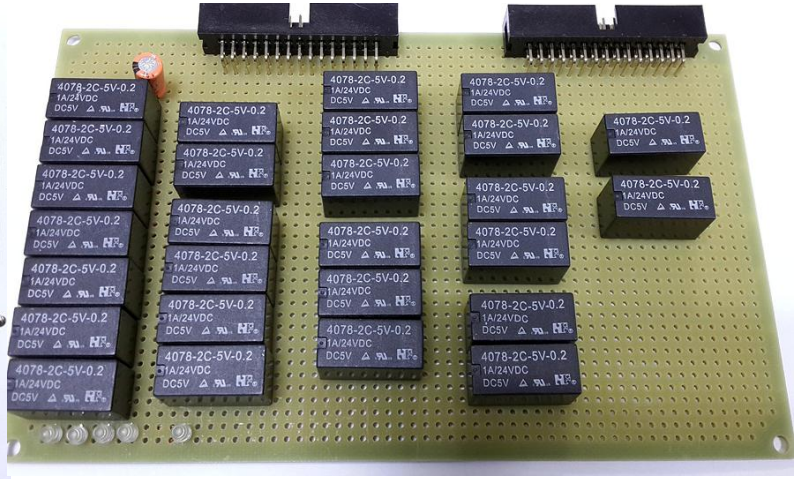
Oscilator, State sequencer, Instruction register, Decoder

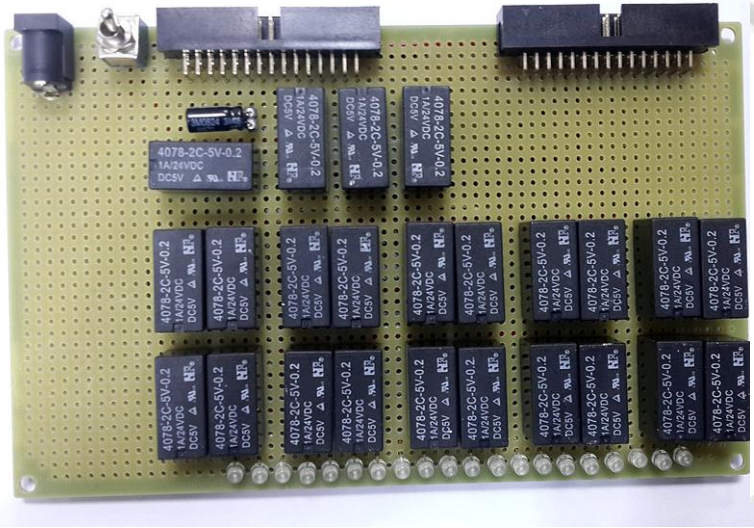
- Timer IC 555 기반 Oscilator, 수동 펄스 입력 가능
- 10-state sequencer
- Instruction register
- Decoder - mux 사용 16가지 opcode 가능

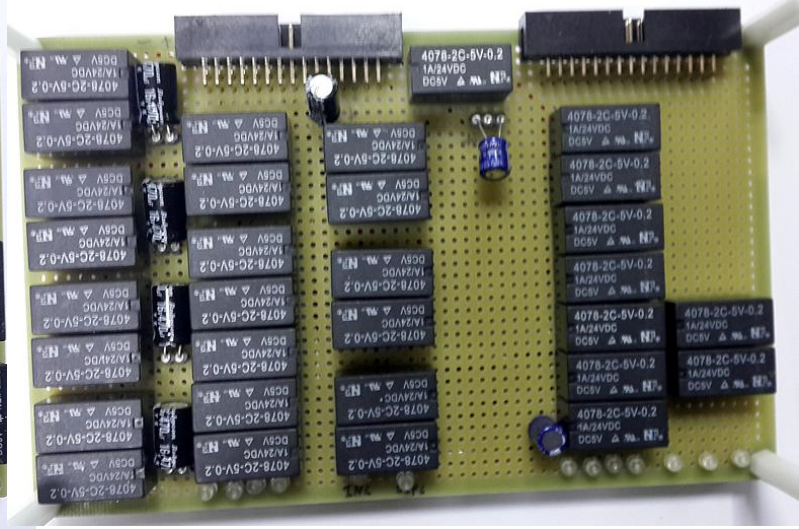


Oscillator, FSM, INR, INC, MAR

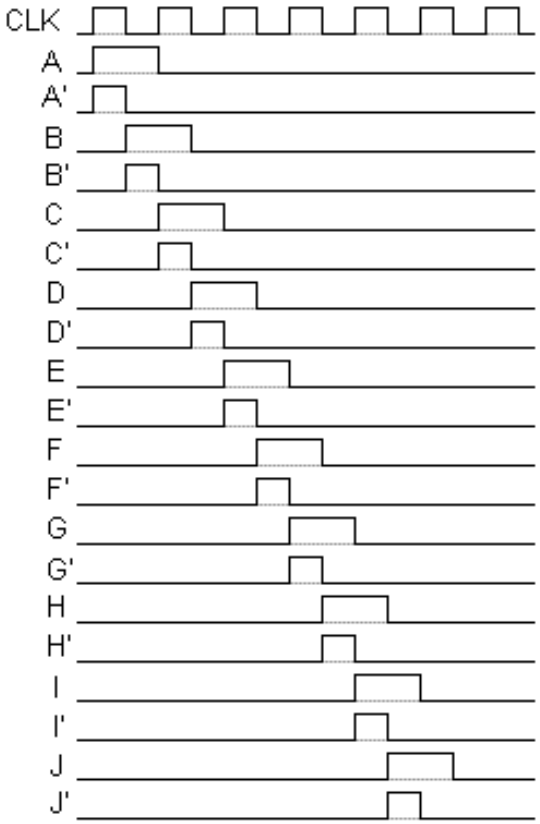


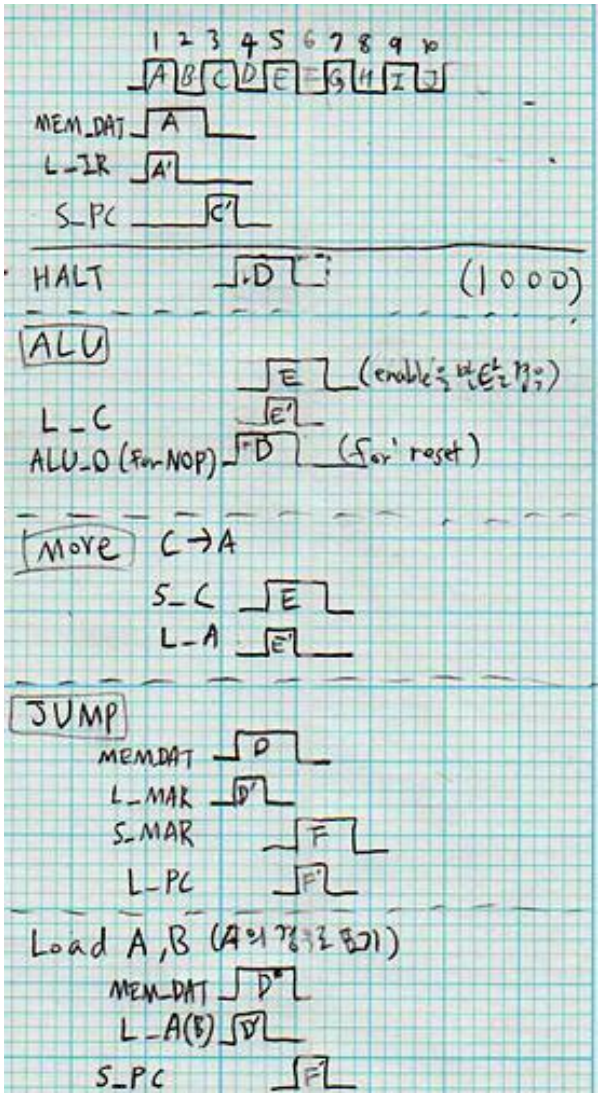






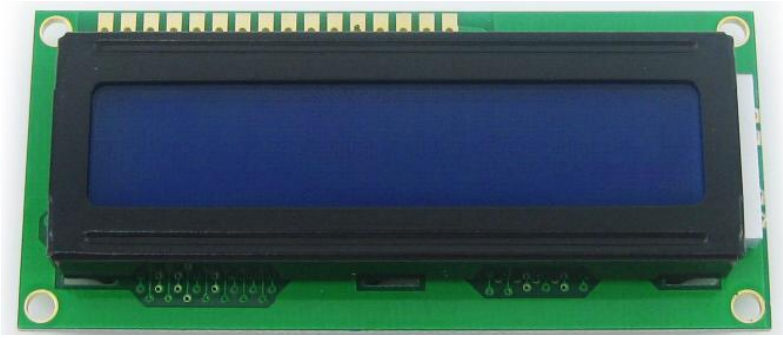
10-State sequencer





Character LCD

- 4비트 제어 가능
- A 레지스터는 제어
- B 레지스터의 2비트는 LCD enable용으로 사용



Upper 4 bits / Lower 4 bits	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	@	P	`	p				ー	タ	ミ	α	p
0001	CG RAM (2)			!	1	A	Q	a	q			。	ア	チ	ム	ä	q
0010	CG RAM (3)			"	2	B	R	b	r			「	イ	ツ	メ	ß	θ
0011	CG RAM (4)			#	3	C	S	c	s			」	ウ	テ	モ	ε	∞
0100	CG RAM (5)			$	4	D	T	d	t			、	エ	ト	ヤ	μ	Ω
0101	CG RAM (6)			%	5	E	U	e	u			・	オ	ナ	ユ	σ	ü
0110	CG RAM (7)			&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
0111	CG RAM (8)			'	7	G	W	g	w			ァ	キ	ヌ	ラ	g	π
1000	CG RAM (1)			(	8	H	X	h	x			ィ	ク	ネ	リ	ッ	X
1001	CG RAM (2)			)	9	I	Y	i	y			ゥ	ケ	ノ	ル	'	y
1010	CG RAM (3)			*	:	J	Z	j	z			ェ	コ	ハ	レ	j	千
1011	CG RAM (4)			+	;	K	[	k	{			ォ	サ	ヒ	ロ	×	万
1100	CG RAM (5)			,	<	L	¥	l	|			ャ	シ	フ	ワ	¢	円
1101	CG RAM (6)			-	=	M	]	m	}			ュ	ス	ヘ	ン	Ł	÷
1110	CG RAM (7)			.	>	N	^	n	→			ョ	セ	ホ	゛	ñ	
1111	CG RAM (8)			/	?	O	_	o	←			ッ	ソ	マ	゜	ö	■

Sample code 1/2

- Printing “Hello World”

Address		DATA	comment
7~4	3~0	-	
0000	0000	0100	; Load A
0000	0001	0010	; Set to 4 bit operation
0000	0010	0100	; Load A
0000	0011	0010	; Function set, 8 bit
0000	0100	0100	; Load A
0000	0101	1000	; 2nd nibble
0000	0110	0100	; Load A
0000	0111	0000	; Display ON, Cursor On, Cursor Blinking
0000	1000	0100	; Load A
0000	1001	1111	; 2nd nibble
0000	1010	0100	; Load A
0000	1011	0000	; Entry Mode, Increment cursor position, No display shift
0000	1100	0100	; Load A
0000	1101	0110	; 2nd nibble
0000	1110	0101	; Load B
0000	1111	0011	; RS=1, lcd not enable
0001	0000	0100	; Load A
0001	0001	0100	; H
0001	0010	0101	; Load B
0001	0011	0001	; RS=1, lcd enable
0001	0100	0100	; Load A
0001	0101	1000	; 2nd nibble
0001	0110	0100	; Load A
0001	0111	0110	; e

Sample code 2/2

Address		DATA	comment
7~4	3~0	-	
0001	1000	0100	; Load A
0001	1001	0101	; 2nd nibble
0001	1010	0100	; Load A
0001	1011	0110	; l
0001	1100	0100	; Load A
0001	1101	1100	; 2nd nibble
0001	1110	0100	; Load A
0001	1111	0110	; l
0010	0000	0100	; Load A
0010	0001	1100	; 2nd nibble
0010	0010	0100	; Load A
0010	0011	0110	; o
0010	0100	0100	; Load A
0010	0101	1111	; 2nd nibble
0010	0110	0100	; Load A
0010	0111	0010	; space
0010	1000	0100	; Load A
0010	1001	0000	; 2nd nibble
0010	1010	0100	; Load A
0010	1011	0101	; w
0010	1100	0100	; Load A
0010	1101	0111	; 2nd nibble
0010	1110	0100	; Load A
0010	1111	0110	; o

Address		DATA	comment
7~4	3~0	-	
0011	0000	0100	; Load A
0011	0001	1111	; 2nd nibble
0011	0010	0100	; Load A
0011	0011	0111	; r
0011	0100	0100	; Load A
0011	0101	0010	; 2nd nibble
0011	0110	0100	; Load A
0011	0111	0110	; l
0011	1000	0100	; Load A
0011	1001	1100	; 2nd nibble
0011	1010	0100	; Load A
0011	1011	0110	; d
0011	1100	0100	; Load A
0011	1101	0100	; 2nd nibble
0011	1110	0000	; NOP
0011	1111	1000	; HALT

시연

감사합니다