



אפקה המכללה האקדמית להנדסה בתל-אביב
AFEKA TEL-AVIV ACADEMIC COLLEGE OF ENGINEERING

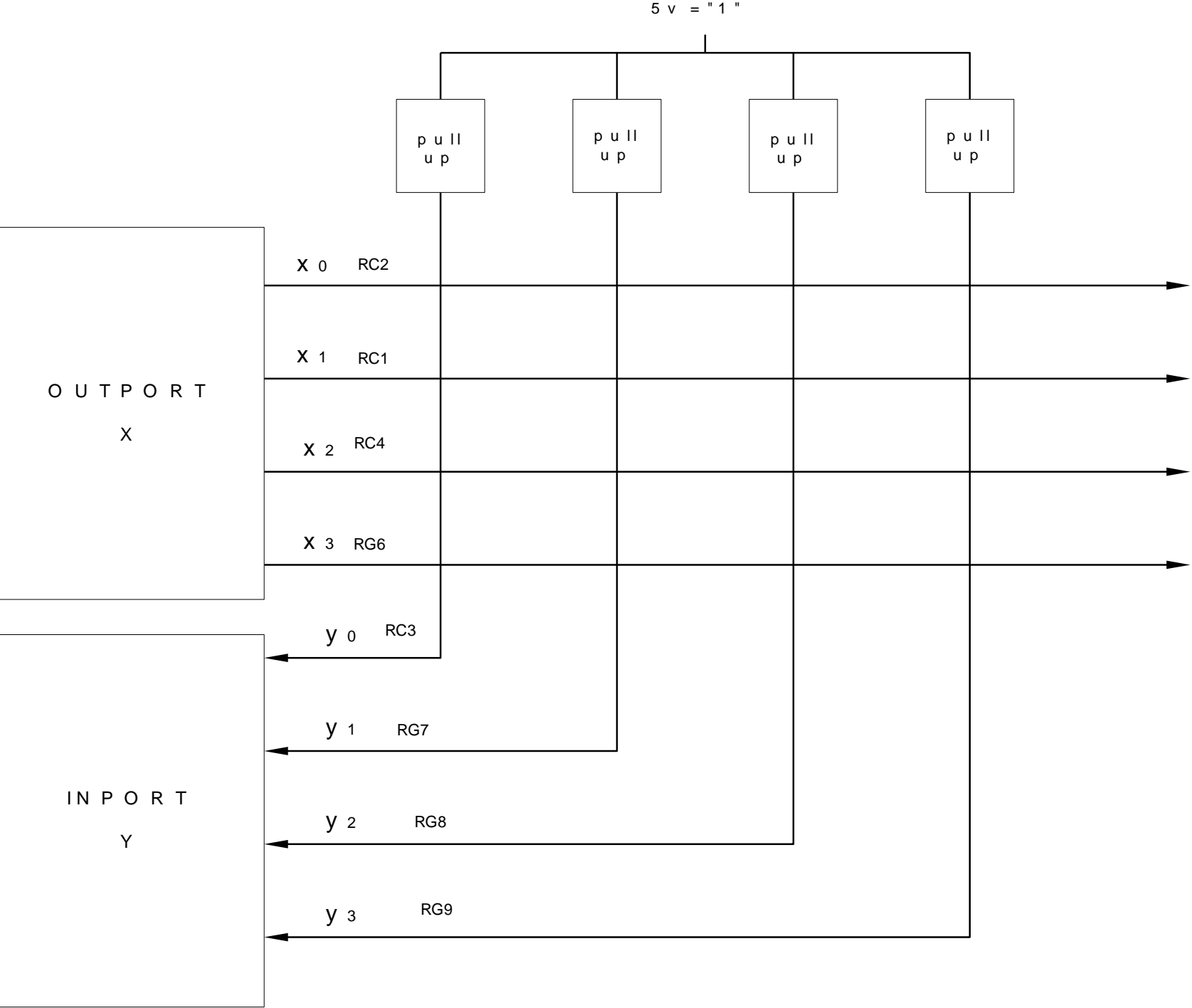
הנדסת תוכנה

Software Engineering

מערכות משובצות מחשב (קורס מס' 10110)

הרצאה – חיבור התקנים בממשק
מטריציאלי

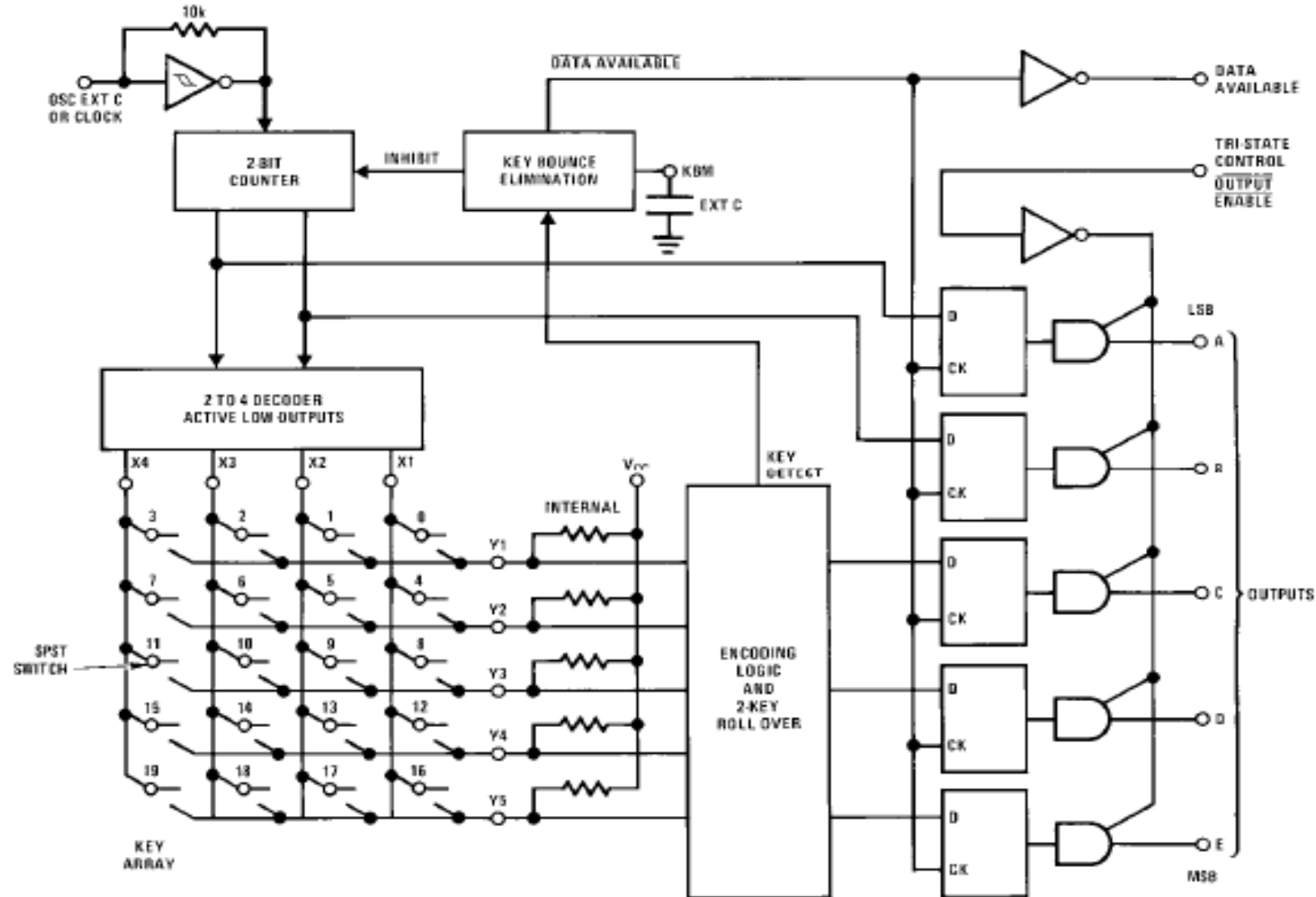
בקורס מערכות משובצות מחשב



Pmod pin	Schematic Label	PIC32 pin
PMODA_1	JA1	RPC2/RC2
PMODA_2	JA2	RPC1/RC1
PMODA_3	JA3	RPC4/CTED7/RC4
PMODA_4	JA4	AN16/C1IND/RPG6/SCK2/PMA5/RG6
PMODA_7	JA7	RPC3/RC3
PMODA_8	JA8	AN17/C1INC/RPG7/PMA4/RG7
PMODA_9	JA9	AN18/C2IND/RPG8/PMA3/RG8
PMODA_10	JA10	AN19/C2INC/RPG9/PMA2/RG9

Pmod pin	Schematic Label	PIC32 pin
PMODB_1	JB1	RPD9/RD9
PMODB_2	JB2	RPD11/PMCS1/RD11
PMODB_3	JB3	RPD10/PMCS2/RD10
PMODB_4	JB4	RPD8/RTCC/RD8
PMODB_7	JB7	SOSCO/RPC14/T1CK/RC14
PMODB_8	JB8	RPD0/RD0
PMODB_9	JB9	AN24/RPD1/RD1
PMODB_10	JB10	SOSCI/RPC13/RC13

Block Diagram



```

/*
 * File: key.c
 * Author: MenachemE
 *
 * Created on July 24, 2019, 6:32 PM
 */
#include <stdio.h>
#include <stdlib.h>
#include <stdio.h>
#include <stdlib.h>
#include <xc.h>
#include <sys/attrs.h>
#include <string.h>
#include <p32xxx.h>
#pragma config JTAGEN = OFF
#pragma config FWDTEN = OFF
#pragma config FNOSC = FRCPLL
#pragma config FSOSCEN = OFF
#pragma config POSCMOD = EC
#pragma config OSCIOFNC = ON
#pragma config FPBDIV = DIV_1
#pragma config FPLLIDIV = DIV_2
#pragma config FPLLMUL = MUL_20
#pragma config FPLLODIV = DIV_1

```

```
void main(void)
```

```
{
TRISA&=0xff00;//led
TRISCbits.TRISC2=0;//RC2
TRISCbits.TRISC1=0;//RC1
TRISCbits.TRISC4=0;//RC4
TRISGbits.TRISG6=0;//RG6
ANSELGbits.ANSG6=0;//???????
TRISCbits.TRISC3 =1;//RC3
CNPUChits.CNPUC3;
TRISGbits.TRISG7=1;//RG7
ANSELGbits.ANSG7=0;
CNPUGbits.CNPUG7;
TRISGbits.TRISG8=1;//RG8
ANSELGbits.ANSG8=0;//???????
CNPUGbits.CNPUG8;//?????
TRISGbits.TRISG9=1;//RG9
ANSELGbits.ANSG9=0;//???????
CNPUGbits.CNPUG9;//?????
while(1)
{
PORTCbits.RC2=0;
PORTCbits.RC1=0;
PORTCbits.RC4=0;
PORTGbits.RG6=0;
PORTAbits.RA0=PORTCbits.RC3;
PORTAbits.RA1=PORTGbits.RG7;
PORTAbits.RA2=PORTGbits.RG8;
PORTAbits.RA3=PORTGbits.RG9;
}
}
```

PULL UP נגדי

```
/*  
 * File: key_xy.c  
 * Author: MenachemE  
 *  
 * Created on July 25, 2019, 4:08 PM  
 */  
#include <stdio.h>  
#include <stdlib.h>  
#include <stdio.h>  
#include <stdlib.h>  
#include <xc.h>  
#include <sys/attrs.h>  
#include <string.h>  
#include <p32xxx.h>  
#pragma config JTAGEN = OFF  
#pragma config FWDTEN = OFF  
#pragma config FNOSC = FRCPLL  
#pragma config FSOSCEN = OFF  
#pragma config POSCMOD = EC  
#pragma config OSCIOFNC = ON  
#pragma config FPBDIV = DIV_1  
#pragma config FPLLIDIV = DIV_2  
#pragma config FPLLMUL = MUL_20  
#pragma config FPLLODIV = DIV_1
```

```
void main(void)
{static int i;
int xy;
TRISA&=0xff00;//led
TRISCbits.TRISC2=0;//RC2
TRISCbits.TRISC1=0;//RC1
TRISCbits.TRISC4=0;//RC4
TRISGbits.TRISG6=0;//RG6
ANSELGbits.ANSG6=0;//???????
TRISCbits.TRISC3 =1;//RC3
CNPUCbits.CNPUC3;          הגדרת נגדי PULL UP
TRISGbits.TRISG7=1;//RG7
ANSELGbits.ANSG7=0;
CNPUGbits.CNPUG7;
TRISGbits.TRISG8=1;//RG8
ANSELGbits.ANSG8=0;//???????
CNPUGbits.CNPUG8;//נגד
TRISGbits.TRISG9=1;//RG9
ANSELGbits.ANSG9=0;//???????
CNPUGbits.CNPUG9;//?????
```



```
while(1)
{
while(1)
{i=1;
PORTCbits.RC2=1;
PORTCbits.RC1=1;
PORTCbits.RC4=1;
PORTGbits.RG6=1;
i=1;
PORTCbits.RC2=0;
xy=in_y(1);
if (xy!=0xff)
break;
PORTCbits.RC2=1;
i=2;
PORTCbits.RC1=0;
xy=in_y(2);
if (xy!=0xff)
break;
PORTCbits.RC1=1;
i=3;
PORTCbits.RC4=0;
xy=in_y(3);
if (xy!=0xff)
break;
PORTCbits.RC4=1;
i=4;
PORTGbits.RG6=0;
xy=in_y(4);
if (xy!=0xff)
break;
PORTGbits.RG6=1;
}
PORTA=xy;
}
}
```

תצוגה של הקוד בעזרת המנורות

```

int in_y( int a)
{ int j=1,flag=0;

    if(!PORTCbits.RC3)
    { flag=1;
      j=1;
    }
    else if (!PORTGbits.RG7)
    { flag=1;
      j=2;
    }
    else if(!PORTGbits.RG8)
    { flag=1;
      j=3;
    }
    else if(!PORTGbits.RG9)
    { flag=1;
      j=4;
    }
    if(flag==0)
        return(0xff);
    else
        return(j|(a<<4));
}

```

בונה את הקוד של שורות ועמודות

```
/*  
 * File: key_xy_ascii.c  
 * Author: MenachemE  
 *  
 * Created on July 26, 2019, 5:51 PM  
 */
```

```
#include <stdio.h>  
#include <stdlib.h>  
#include <stdio.h>  
#include <stdlib.h>  
#include <xc.h>  
#include <sys/attrs.h>  
#include <string.h>  
#include <p32xxxx.h>  
#pragma config JTAGEN = OFF  
#pragma config FWDTEN = OFF  
#pragma config FNOSC = FRCPLL  
#pragma config FSOSCEN = OFF  
#pragma config POSCMOD = EC  
#pragma config OSCIOFNC = ON  
#pragma config FPBDIV = DIV_1  
#pragma config FPLLIDIV = DIV_2  
#pragma config FPLLMUL = MUL_20  
#pragma config FPLLODIV = DIV_1
```

```
void main(void)
{static int i;
int xy;
char scan_key[]={0x44,'1',0x34,'2',0x24,'3',0x43,'4',0x33,'5',0x23,'6',0x42,'7',0x32,'8',0x22,'9',0x41,'0'};
TRISA&=0xff00;//led
TRISCbits.TRISC2=0;//RC2
TRISCbits.TRISC1=0;//RC1
TRISCbits.TRISC4=0;//RC4
TRISGbits.TRISG6=0;//RG6
ANSELGbits.ANSG6=0;//???????
TRISCbits.TRISC3 =1;//RC3
CNPUCbits.CNPUC3;
TRISGbits.TRISG7=1;//RG7
ANSELGbits.ANSG7=0;
CNPUGbits.CNPUG7;
TRISGbits.TRISG8=1;//RG8
ANSELGbits.ANSG8=0;//???????
CNPUGbits.CNPUG8;//?????
TRISGbits.TRISG9=1;//RG9
ANSELGbits.ANSG9=0;//???????
CNPUGbits.CNPUG9;//?????
```

התוכנית מחזירה את הערך ו־ASCII של הלחצן

```
while(1)
{
while(1)
{i=1;

PORTCbits.RC2=1;
PORTCbits.RC1=1;
PORTCbits.RC4=1;
PORTGbits.RG6=1;
i=1;
PORTCbits.RC2=0;
xy=in_y(1);
if (xy!=0xff)
    break;
PORTCbits.RC2=1;
i=2;
PORTCbits.RC1=0;
xy=in_y(2);
if (xy!=0xff)
    break;
PORTCbits.RC1=1;
i=3;
PORTCbits.RC4=0;
xy=in_y(3);
if (xy!=0xff)
    break;
PORTCbits.RC4=1;
i=4;
PORTGbits.RG6=0;
xy=in_y(4);
if (xy!=0xff)
    break;
PORTGbits.RG6=1;
}
for(i=0;i<20;i+=2)
    if(scan_key[i]==xy)

PORTA=scan_key[i+1];
}
}
```

```
int in_y( int a)
{ int j=1,flag=0;
  if(!PORTCbits.RC3)
  { flag=1;
    j=1;
  }
  else if (!PORTGbits.RG7)
  { flag=1;
    j=2;
  }
  else if(!PORTGbits.RG8)
  { flag=1;
    j=3;
  }
  else if(!PORTGbits.RG9)
  { flag=1;
    j=4;
  }
  if(flag==0)
    return(0xff);
  else
    return(j|(a<<4));

}
```

כתיבה ל-LCD מספר המקש

```
for(i=0;i<20;i+=2)
    if(scan_key[i]==xy)

//PORTA=scan_key[i+1];
    PORTE=scan_key[i+1];
    PORTDbits.RD4=1;
    PORTDbits.RD4=0;
    //for(j=0;j<32000;j++);
    busy();
```

השהיות בין הלחיצות כדי לקבל לחיצה בודדת

```
//PORTA=scan_key[i+1];  
    PORTE=scan_key[i+1];  
    PORTDbits.RD4=1;  
    PORTDbits.RD4=0;  
    //for(j=0;j<32000;j++);  
    busy();  
for(i=0;i<64000;i++);  
for(i=0;i<64000;i++);  
for(i=0;i<64000;i++);  
for(i=0;i<64000;i++);  
for(i=0;i<64000;i++);  
for(i=0;i<64000;i++);
```


בין הלחיצות יש צורך בעזיבה של המקש

```
PORTCbits.RC2=0;  
PORTCbits.RC1=0;  
PORTCbits.RC4=0;  
PORTGbits.RG6=0;  
while(!PORTCbits.RC3);  
while(!PORTGbits.RG7);  
while(!PORTGbits.RG8);  
while(!PORTGbits.RG9);
```

קטע התוכנית עזר לניסוי 4 לחיצה מקש 1 מונה UP מקש 2 מונה down

```
while(1)
{
    key= scan_key();
    if(key!=0xff)
    flag_scan=key;
    if( flag_scan=='1')
        PORTA++;
    if(flag_scan=='2')
        PORTA--;
    for(j=0;j<32000;j++);
}
```

```

int scan_key()
{int i=1;
char scan_key[]={0x44,'1',0x34,'2',0x24,'3',0x43,'4',0x33,'5',0x23,'6',
                 0x42,'7',0x32,'8',0x22,'9',0x41,'0'};
int xy,counter;
int flag=0;
for(counter=0;counter<1000;counter++)
{
PORTCbits.RC2=1;
PORTCbits.RC1=1;
PORTCbits.RC4=1;
PORTGbits.RG6=1;
PORTCbits.RC2=0;
xy=in_y(1);
if (xy!=0xff)
    break;
PORTCbits.RC2=1;
PORTCbits.RC1=0;
xy=in_y(2);
if (xy!=0xff)
    break;
PORTCbits.RC1=1;
PORTCbits.RC4=0;
xy=in_y(3);
if (xy!=0xff)
    break;
PORTCbits.RC4=1;
PORTGbits.RG6=0;
xy=in_y(4);
if (xy!=0xff)
    break;
PORTGbits.RG6=1;
}
if(xy==0xff)
    return(0xff);

```

```

PORTBbits.RB15=1;//rs=1 control ascii
for(i=0;i<20;i+=2)
    if(scan_key[i]==xy)

//PORTA=scan_key[i+1];
    PORTE=scan_key[i+1];
    PORTDbits.RD4=1;
    PORTDbits.RD4=0;
    //for(j=0;j<32000;j++);
    busy();
    //PORTC=0;
PORTCbits.RC2=0;
PORTCbits.RC1=0;
PORTCbits.RC4=0;
PORTGbits.RG6=0;
while(!PORTCbits.RC3);
while(!PORTGbits.RG7);
while(!PORTGbits.RG8);
while(!PORTGbits.RG9);
    return(PORTE);
}

```

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