PX318J
Application Note
006

Example Code

Version	Date	Description	Author
1.00	2019/08/06	Create the file	Rocky Hsiao
1.01	2020/07/20	#define PsPuw (0x20) revise (0x10)	Robert Chan
1.02	2020/7/23	The calibration process has a headroom of 10cm changed to 100mm	Robert Chan
1.03	2020/7/27	Modify the initialization PsPuc Register address 0x61 to 0x62	Robert Chan
1.04	2022/03/02	Modify the Function-AutoDac() and remove Fixed-point	Brian Chiu

px318j.h

```
//Function form MCU
extern uint32_t MCU_I2C_Write(uint8_t devid, uint8_t reg, uint8_t* data, uint8_t num);
extern uint32_t MCU_I2C_Read(uint8_t devid, uint8_t reg, uint8_t* data, uint8_t num);
extern void MCU_Delay_ms(uint32_t millisecond);

//#define FIXEDPT_BITS 32
//I2C device address (7bits)
//SEL PIN = Float,      address = 0x1D
//SEL PIN = VDD,        address = 0x1F
//SEL PIN = GND,        address = 0x1C
#define PX318J_ID                      (0x1C)
#define PsBits                         (0x01)    //ADC output = 10-bits
#define PsMean                         (0x00)    //Mean = 1 time
#define PsCtrl                         ((PsBits << 4) | (PsMean << 6) | (0x05))

#define PsPuw                          (0x10)    // VSCEL pulses width, 0x10 width = 32 us
#define PsPuc                          (0x02)    // VSECL pulses count, 0x02 = 2 counts

#define PsDrv                          (0x0B)    // VSCEL driving current, 0x0b = 12 mA
#define PsDrvCtrl                      (PsDrv)

#define WaitTime                       (0x11)    // Sensor waiting time 0x11 = 170 ms

#define PsWaitAlgo                     (0x01)
#define PsIntAlgo                      (0x01)
#define PsPers                         (0x04)
//PsInt asserted after 4 consecutive PsData meets the PsInt criteria
#define PsAlgoCtrl                     ((PsWaitAlgo << 5) | (PsIntAlgo << 4) | (PsPers))

#define DefaultThreshold               1         //1 = fixed threshold, 0 = factory threshold
#define PsDefaultThresholdHigh         600
#define PsDefaultThresholdLow          400
#define LoadCtCalibrationSetting       0         //1 = load close talk calibration setting

#define PXY_FULL_RANGE                 ((1 << (PsBits + 9)) - 1)
#define TARGET_PXY                     ((PXY_FULL_RANGE + 1) >> 2)

void PX318J_enable(uint8_t addr);
uint8_t PX318J_auto_dac(uint8_t addr);
```

px318j.c

Function list：

```
//*******************************************************************
void PX318J_I2C_Write(uint8_t addr,uint8_t reg, uint8_t data)
{
     MCU_I2C_Write(addr, reg, &data, 1);
}


//*******************************************************************
void PX318J_I2C_Write_Word(uint8_t addr, uint8_t reg, uint16_t data)
{
     uint8_t value[2];

     value[0] = data & 0x00FF;
     value[1] = data >> 8;

     MCU_I2C_Write(addr, reg, value, 2);
}


//*******************************************************************
void PX318J_I2C_Read(uint8_t addr, uint8_t reg, uint8_t* data)
{
     MCU_I2C_Read(addr, reg, data, 1);
}

//*******************************************************************
uint16_t PX318J_I2C_Read_Word(uint8_t addr, uint8_t reg, uint8_t* data, uint16_t mask)
{
     uint16_t value;

     MCU_I2C_Read(addr, reg, data, 2);

     value = data[1];
     value <<= 8;
     value |= data[0];

     value &= mask;

     return value;
}


//*******************************************************************
void PX318J_enable(uint8_t addr, uint8_t enable)
{
     if (px318j_enable)
     {
          PX318J_I2C_Write(addr, 0xF0, 0x02);
          MCU_Delay_ms(10);
     }
     else
     {
          PX318J_I2C_Write(addr, 0xF0, 0x00);
          MCU_Delay_ms(5);
     }
}
```

Initial Sensor

```
#if LoadCtCalibrationSetting
uint8_t PsDacCtrl = 0;
uint8_t PsCtDac = 0;
uint8_t PsCalL = 0;
uint8_t PsCalH = 0;
#endif

PX318J_I2C_Write(PX318J_ID, 0xF4, 0xEE);     // soft reset
DelayMs(30);                                 // waiting for soft reset
PX318J_I2C_Write(PX318J_ID, 0x60, PsCtrl);   // ADC output = 10-bits, Mean = 1
PX318J_I2C_Write(PX318J_ID, 0x61, PsPuw);    // VSCEL pulses width, 0x10 width = 32 us
PX318J_I2C_Write(PX318J_ID, 0x62, PsPuc);    // VSECL pulses count, 0x02 = 2 counts
PX318J_I2C_Write(PX318J_ID, 0x64, PsDrv);    // VSCEL driving current, 0x0b = 12 mA
PX318J_I2C_Write(PX318J_ID, 0x4F, WaitTime); // Sensor waiting time 0x11 = 170 ms

//High, Low Threshold setting path. Form default or factory calibration value
#if DefaultThreshold
PX318J_I2C_Write_Word(PX318J_ID, 0x6C, PsDefaultThresholdLow);
PX318J_I2C_Write_Word(PX318J_ID, 0x6E, PsDefaultThresholdHigh);
#else
// load threshold value from flash memory (add by customer)

// PX318J_I2C_Write_Word(PX318J_ID, 0x6C, FACOTRY_L_THRESHOLD);
// PX318J_I2C_Write_Word (PX318J_ID, 0x6E, FACOTRY_H_THRESHOLD);
#endif

#if LoadCtCalibrationSetting
// load calibration value from flash memory (add by customer)

PX318J_I2C_Write(PX318J_ID, 0x65, PsDacCtrl);    //set PsDacCtrl
PX318J_I2C_Write(PX318J_ID, 0x67, PsCtDac); //set PsCtDac
PX318J_I2C_Write(PX318J_ID, 0x69, PsCalL);  //set PsCal
PX318J_I2C_Write(PX318J_ID, 0x6A, PsCalH);  //set PsCal
#endif

PX318J_I2C_Write(PX318J_ID, 0xFE, 0x00);    // clear status flag
PX318J_enable(PX318J_ID, 1);                //PX318J Enable
```

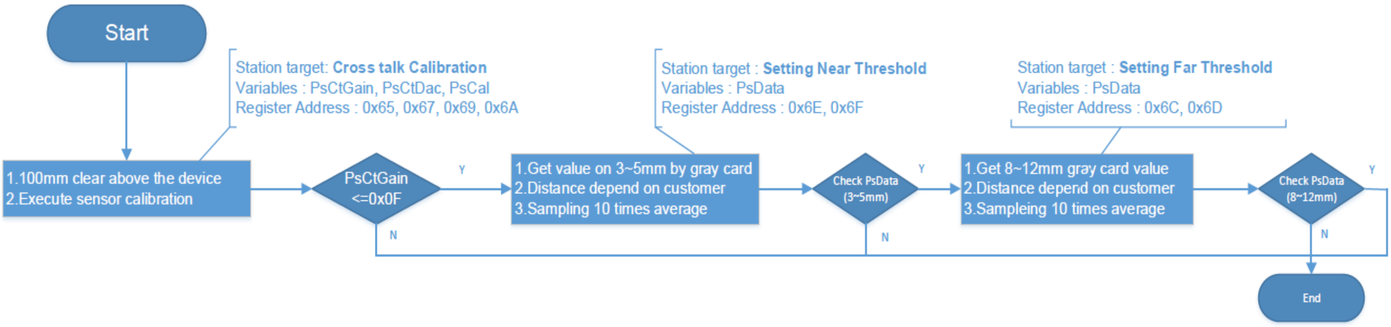
Polling

```
while(1)
{
     uint8_t near_far_flag = 0;
     uint8_t buf = 0;
     PX318J_I2C_Read(PX318J_ID, 0xFF, &buf)              //read near / far status
     if (buf & 0x80)
         near_far_flag = 1; //far event
     else
         near_far_flag = 0; //near event
     DelayMs(30); // waiting for sensor output ready
}
```

ISR

```
PX318J_ISR()
{
     uint8_t near_far_flag = 0;
     uint8_t buf = 0;
     PX318J_I2C_Read(PX318J_ID, 0xFE, &IntFlag)        //Check Interrupt status
     if (IntFlag & 0x02) {// checking PsInt, make sure the ISR is from sensor
          PX318J_I2C_Read(PX318J_ID, 0xFF, &buf)       //read near / far status
          if (buf & 0x80)
               near_far_flag = 1;            //far event
          else
               near_far_flag = 0;            //near event
          PX318J_I2C_Write(PX318J_ID, 0xFE, 0x00);     //release interrupt pin and flag
     }
}
```

Crosstalk calibration and High / Low threshold calibration flow


Start
Station target: Cross talk Calibration
Variables : PsCtGain, PsCtDac, PsCal
Register Address : 0x65, 0x67, 0x69, 0x6A
Station target : Setting Near Threshold
Variables : PsData
Register Address : 0x6E, 0x6F
Station target : Setting Far Threshold
Variables : PsData
Register Address : 0x6C, 0x6D
1.100mm clear above the device
2.Execute sensor calibration
PsCtGain
<=0x0F
Y
N
1.Get value on 3~5mm by gray card
2.Distance depend on customer
3.Sampling 10 times average
Check PsData
(3~5mm)
Y
N
1.Get 8~12mm gray card value
2.Distance depend on customer
3.Sampleing 10 times average
Check PsData
(8~12mm)
Y
N
End

How to do crosstalk calibration

1. Using the assembled machine, face the sensor of the device in a direction without any cover.
2. Executing the calibration program.
3. Write the relevant calibration values into the MCU flash memory.

Sensor crosstalk calibration：

```
uint8_t PX318J_auto_dac(void)
{
    uint8_t addr = PX318J_ID;
    uint8_t buff[5] = {0};
    uint16_t PsData = 0;
    bool first_data = true;

    //Setting Variable
    uint8_t PsCtDac = 0;
    uint8_t PsDacCtrl = 0;
    uint8_t PsCtGain = 0;
    int16_t Dac_temp = 0;

    //PI Control variable
    bool PI_Control = true;
    int32_t dp = 0;
    int32_t di = 0;
    uint8_t last_try = 0;

    //Bisection method
    uint8_t DacMax = 96;
    uint8_t DacMin = 1;

    //Sensor Initial
    PX318J_I2C_Write(addr, 0x60, PsCtrl);
    PX318J_I2C_Write(addr, 0x61, PsPuw);
    PX318J_I2C_Write(addr, 0x62, PsPuc);
    PX318J_I2C_Write(addr, 0x64, PsDrvCtrl);
    PX318J_I2C_Write(addr, 0x4F, 0x00);              //WaitTime = 0
    PX318J_I2C_Write(addr, 0x65, 0x01);              //Reset PsDacCtrl
    PX318J_I2C_Write(addr, 0x67, 0x00);              //Reset PsCtDac
    PX318J_I2C_Write(addr, 0x69, 0x00);              //Reset PsCal
    PX318J_I2C_Write(addr, 0x6A, 0x00);              //Reset PsCal
    PX318J_I2C_Write(addr, 0xF1, 0x01);              //Close INT pin output
    PX318J_I2C_Write(addr, 0xF2, 0x10);              //Enable Data Ready Interrupt Halt
    PX318J_I2C_Write(addr, 0xFE, 0x00);              //Clear Interrupt Flag
    PX318J_I2C_Write(addr, 0x80, 0x08);              //Enable Fast-En(Factor function)

    px318j_enable(addr, 1);                          //Enable Sensor

    PsCtGain = 0x01;
    PsDacCtrl = PsCtGain;
    PsCtDac = 0x00;

    //First Step
    while (1)
    {
        if (MCU_I2C_Read(addr, 0xFE, buff, 4) != STATUS_OK)  //Get Interrupt flag and PS Data.
            return 0;

        if ((buff[0] & 0x10) == 0x10) //Data Ready flag
        {
            PsData = (uint16_t)buff[2] + ((uint16_t)buff[3] << 8);

            if (first_data)          //Ignore the first data.
            {
                first_data = false;
                PX318J_I2C_Write(addr, 0xFE, 0x00);    //Clear Interrupt Flag
                continue;
            }

            //With last try and PS Data > 0, finish the calibration else keep going.
            if (last_try == 1 && PsData > 0)
                break;
```

```
else
    last_try = 0;

if (PsCtDac > 0)
{
    //The PsCtDac is over spec, try to use the bisection method to get the right
    setting.
    if (PsData == 0)
    {
        DacMax = (uint8_t)PsCtDac;
        PI_Control = false;
    }
    //PS Data <= target value, finish the calibration.
    else if (PsData <= TARGET_PXY)
        break;
    //With the bisection method, we get the last value. finish calibration.
    else if (PsCtDac == DacMin || PsCtDac == DacMax)
        break;
}
//PS Data <= target value, finish the calibration.
else if (PsData <= TARGET_PXY)
    break;

if (PI_Control)     //Get the setting with PI control.
{
    dp = PsData - TARGET_PXY;
    di += dp;


    Dac_temp = (int16_t)PsCtDac
    + (int16_t)((dp >> 6) + ((di >> 6) + (di >>8))) + (dp >=0 ? 1 : -1);

    if (Dac_temp >= 96)
    {
        if (PsCtGain == 0x0F)
        {
            last_try = 1;
            Dac_temp = 96;
        }
        else
        {
            if (dp > (TARGET_PXY <<1))  //If PS Data > (target value) x 2
            {
               PsCtGain <<=1;          //New PsCtGain = PsCtGain x2
            }
            else if (dp > TARGET_PXY) //If PS Data > target value
            {
               PsCtGain +=2;           //New PsCtGain = PsCtGain + 2
            }
            else
            {
               PSCtGain++;             // New PsCtGain = PsCtGain + 1
            }

            if (PsCtGain == 0x00)
                PsCtGain = 1;
            else if (PsCtGain > 0x0F)
                PsCtGain = 0x0F;

            Dac_temp = 48;

            PsDacCtrl = (PsDacCtrl & 0xF0) | PsCtGain;
            PX318J_I2C_Write(addr, 0x65, PsDacCtrl);
        }
    }
}
```

```
            else
            {
                if (PsData > TARGET_PXY)
                    DacMin = (uint8_t)Dac_temp;

                if (PsData < PXY_FULL_RANGE && PsData > TARGET_PXY)  //Reduce calculate time.
                    Dac_temp += 1;
                else
                    Dac_temp = (uint16_t)(DacMin + DacMax) >> 1;
            }

            PsCtDac = (uint8_t)Dac_temp;

            PX318J_I2C_Write(addr, 0x67, PsCtDac);
            PX318J_I2C_Write(addr, 0xFE, 0x00);    //Clear Interrupt Flag
        }
    }

    PX318J_enable(addr, 0);                 //Shutdown sensor
    PX318J_I2C_Write(addr, 0xFE, 0x00);    //Clear IntFlag
    PX318J_I2C_Write(addr, 0xF2, 0x00);    //DataHalt Disable
    PX318J_I2C_Write(addr, 0x80, 0x00);    //FastEn Disable

    //Second Step
    PX318J_enable(addr, 1);                 //Enable sensor

    uint8_t index = 0;
    uint32_t Sum = 0;
    do
    {
        MCU_I2C_Read(addr, 0xFE, buff, 4);
        if ((buff[0] & 0x10) == 0x10)
        {
            PsData = (uint16_t)buff[2] + ((uint16_t)buff[3] << 8);

            buff[0] = 0x00;
            PX318J_I2C_Write(addr, 0xFE, 0x00);
            if(index > 1)  //Ignore the first two data
                Sum += PsData;
            index++;
        }
    }while (index < 10);

    PX318J_enable(addr, 0);                 //Shutdown sensor
    PsData = (uint16_t)(Sum >> 3) + 20;

    PX318J_I2C_Write_Word(addr, 0x69, PsData);
    PX318J_I2C_Write(addr, 0xF1, 0x03);         // Open INT pin output
    PX318J_I2C_Write(addr, 0x4F, WaitTime);     //WaitTime = 170ms

    //Save calibration value to flash memory (this function have to add by customer)
    //reg 0x65 (PsDacCtrl)
    //reg 0x67 (PsCtDac)
    //reg 0x69, 0x6a (PsData)


    PX318J_enable(addr, 1);                      //Enable sensor

    return 1;
}
```

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