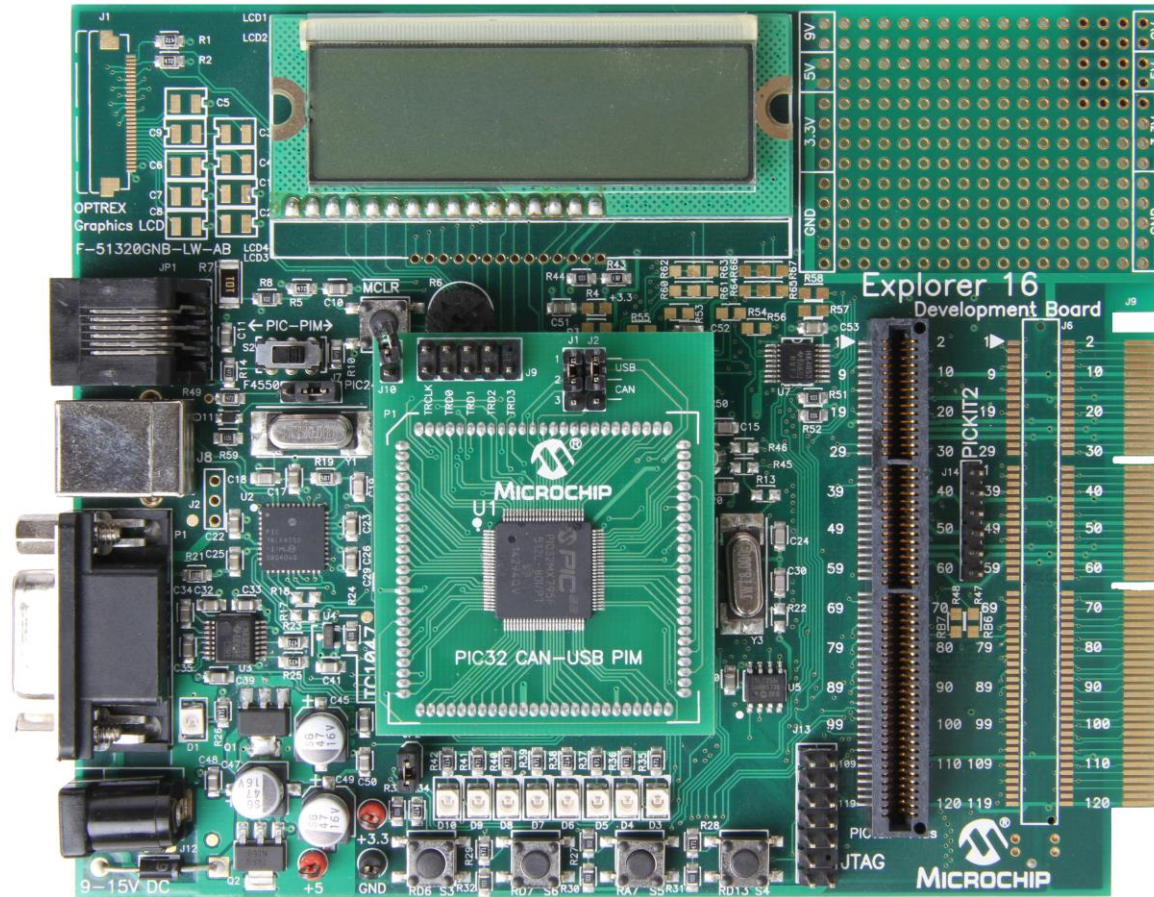


IoT Development Tools for PIC32



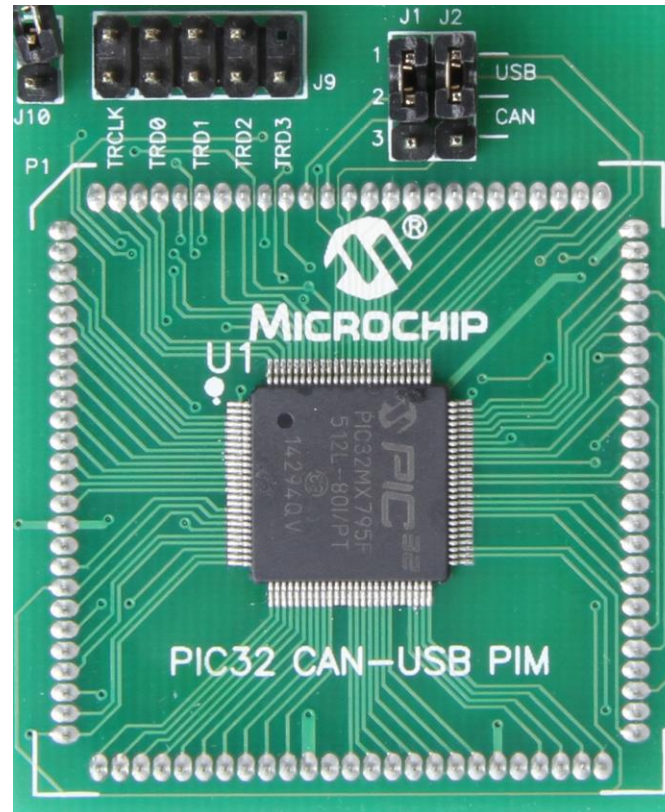
Explorer 16/32 Development Board

January 30, 2018

FRED EADY

AGENDA

- Explorer 16/32 Development Board Hardware
- GPS click Project
- Double click – Shake2Wake click Project
- Nos Vemos Mañana

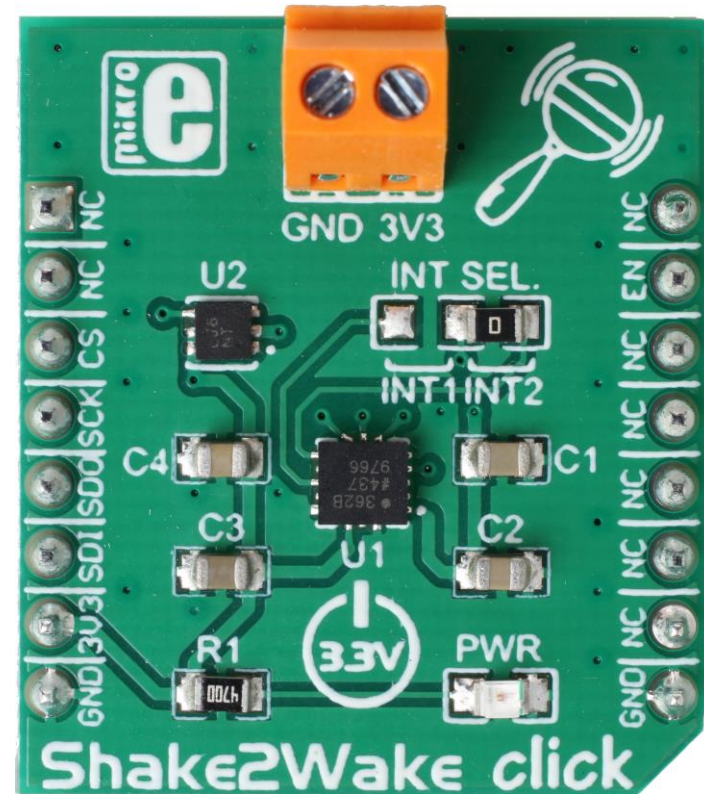


IoT Development Tools for PIC32

Explorer 16/32 Development Board Hardware – [click Part Numbers](#)



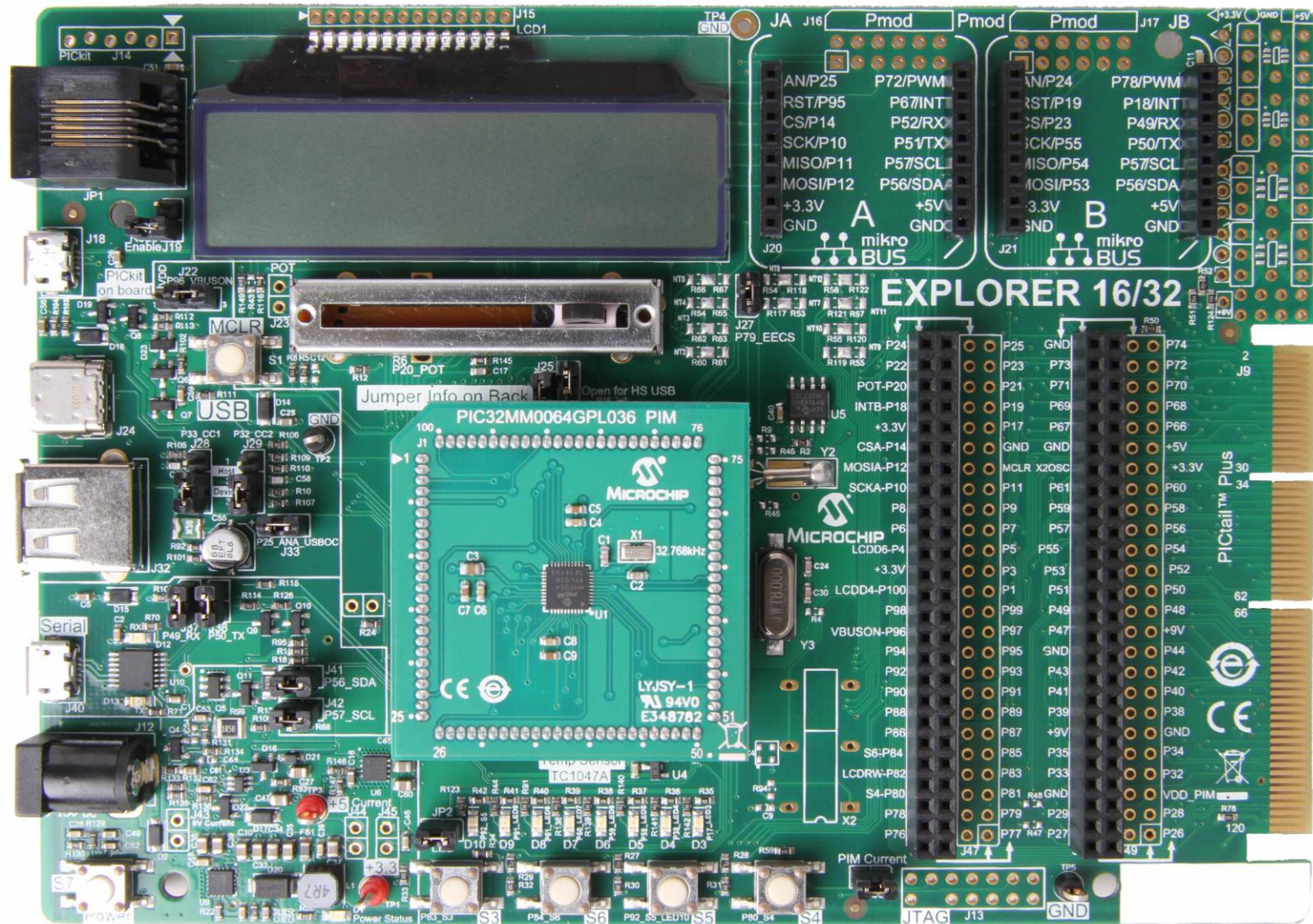
GPS CLICK UART/I2C
MIKROE-1032
1471-1009-ND



SHAKE2WAKE CLICK
MIKROE-1942
1471-1498-ND

IoT Development Tools for PIC32

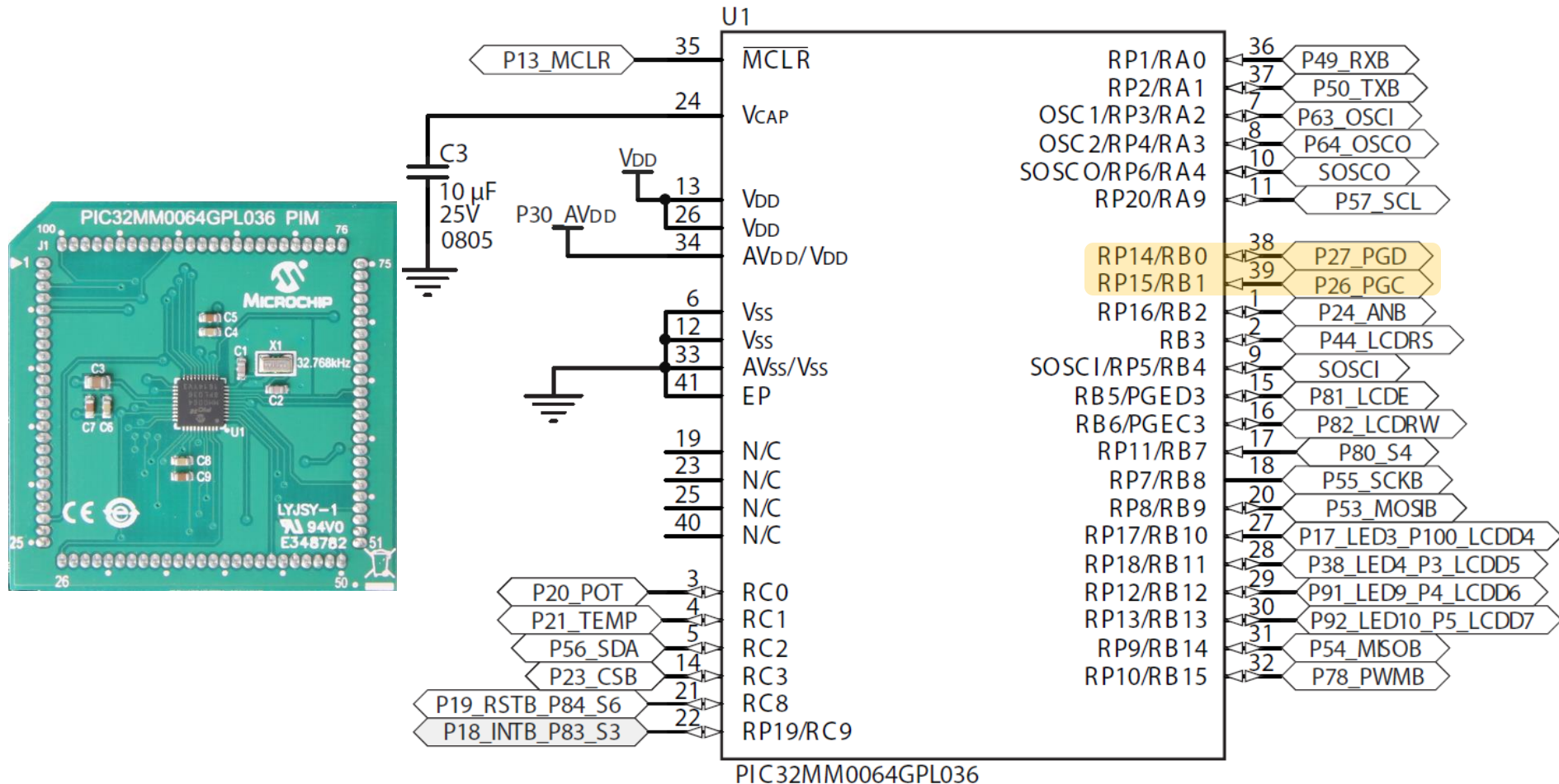
Explorer 16/32 Development Board Hardware



IoT Development Tools for PIC32

Explorer 16/32 Development Board Hardware

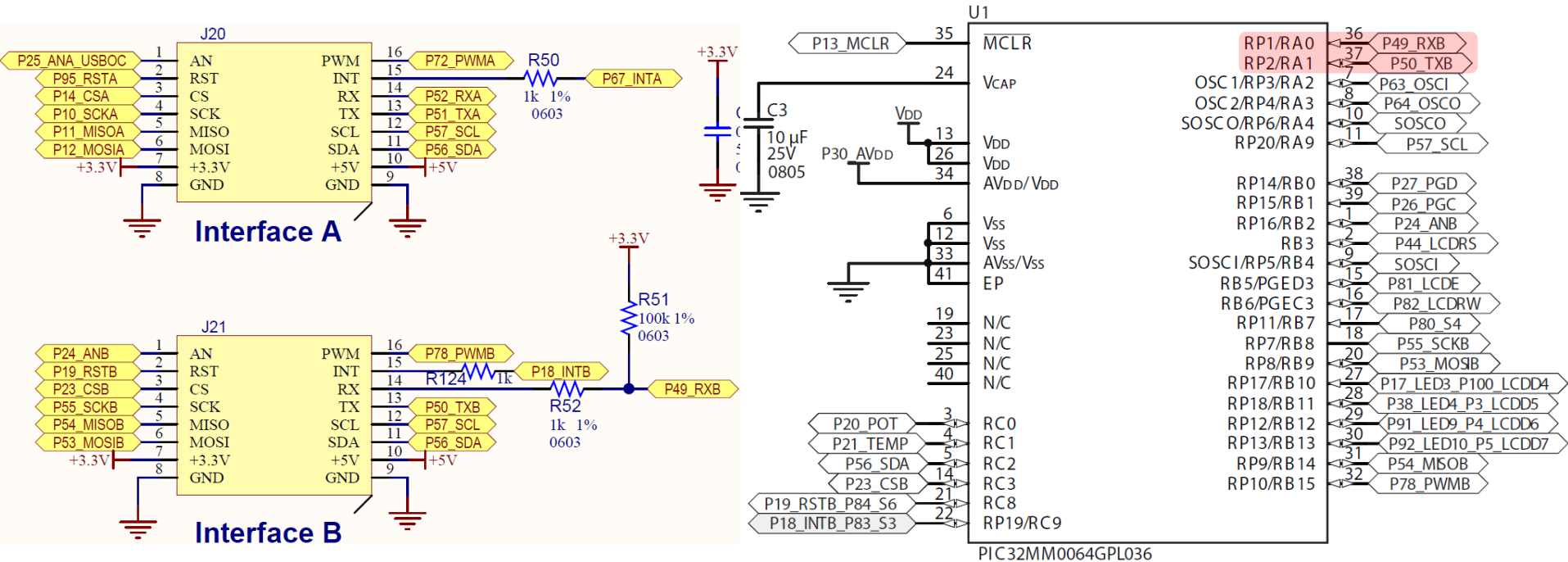
Locate Programming Pins



IoT Development Tools for PIC32

Explorer 16/32 Development Board Hardware

Locate UART Pins



IoT Development Tools for PIC32

Explorer 16/32 Development Board Hardware

MCC Setup

MPLAB X IDE v4.05 - explorer16_32_GPS : explorer16_32_GPS

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

explorer16_32_GPS 732.3/166.0MB MCC PC: 0x0 How do I? Keyword(s)

Projects Files Services **Resource Management [MCC]**

Project Resources Generate Import... Export

- System
 - Interrupt Module
 - Pin Module
 - System Module
- Peripherals
 - UART2 [PIC24 / dsPIC33 / PIC32MM MCUs by Microchip Technology, Inc.]

Device Resources

- Comparator
- Ext_Interrupt
- HLVD
- MCCP
- RTCC
- SPI
- Timer
- UART
- Libraries
 - Foundation Services
 - LIN
 - Mikro-E Clicks

System Module

Easy Setup Registers

INTERNAL OSCILLATOR

8000000 Hz Primary Oscillator (3.5 MHz - 25 MHz) Clock Source

☐ FRC Postscaler

☒ PLL Enable

24 MHz 3:1 Multiplier

24 MHz 1:1 Divider

24 MHz SYSCLK

24 MHz PBCLK

Click Output Pin Configuration System clock is connected to CLK0/OSC1 pin

Pin Manager: Package View

PIC32MM0064GPL036

Pin Manager: Grid View

Package:	UQFN40	Pin No:	36	37	7	8	10	11	38	39	1	2	9	15	16	17	18	20	27	28	29	30	31	32	3	4	5	14	21	22
			Port A										Port B										Port C							
			0	1	2	3	4	9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	8	9
Module		Function																												
ICD		PGCx																												
		PGDx																												
		CLKI																												
		CLKO																												
OSC		OSC1																												
		OSCO																												
		REFCLKI																												
		REFCLKO																												
		SOSCI																												
		SOSCO																												
Pin Module		GPIO																												
		GPIO																												
		U2CTS																												
UART2		U2RTS																												
		U2RX																												
		U2TX																												

explorer16_32_GPS - Das... x CLICK_GPS_Tasks() - Navig... Versions [MCC]

explorer16_32_GPS

Project Type: Application - Configuration: explorer16_32_GPS

Device

PIC32MM0064GPL036

Checksum: Debug Image

Compiler Toolchain

XC32 (v1.44) [C:\Program Files (x86)\Microchip\xc32\v1.44\bin]

Debug Image: ELF: Optimization:

Linker Reserved Heap: 16 (0x10) bytes

Memory

Data 8192 (0x2000) bytes

22%

Data Used: 1820 (0x71C) Free: 6372 (0x18E4)

Program 65536 (0x10000) bytes

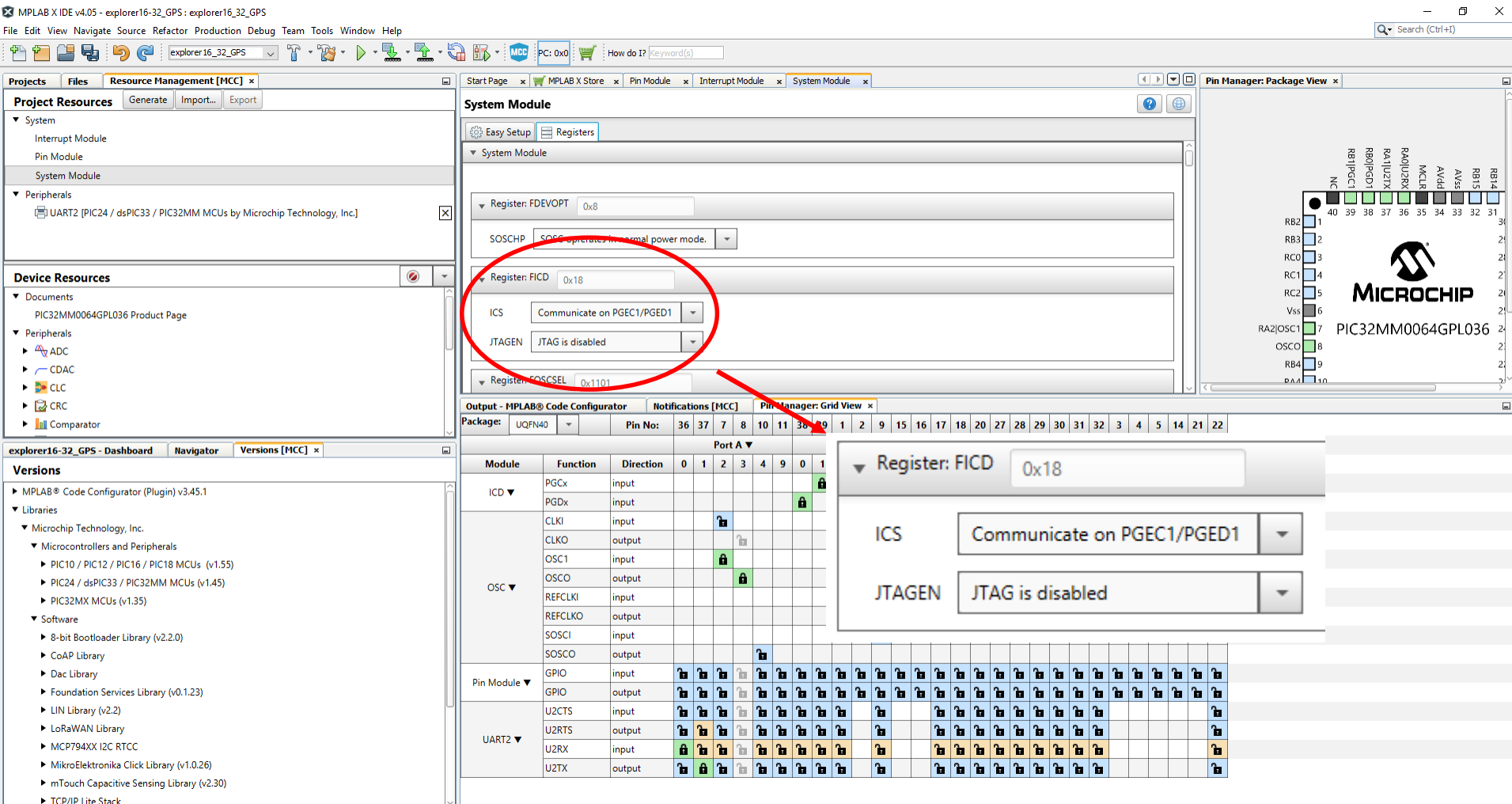
35%

Program Used: 22872 (0x5958) Free: 42664 (0xA6A8)

explorer16_32_GPS (Build, Load, ...)

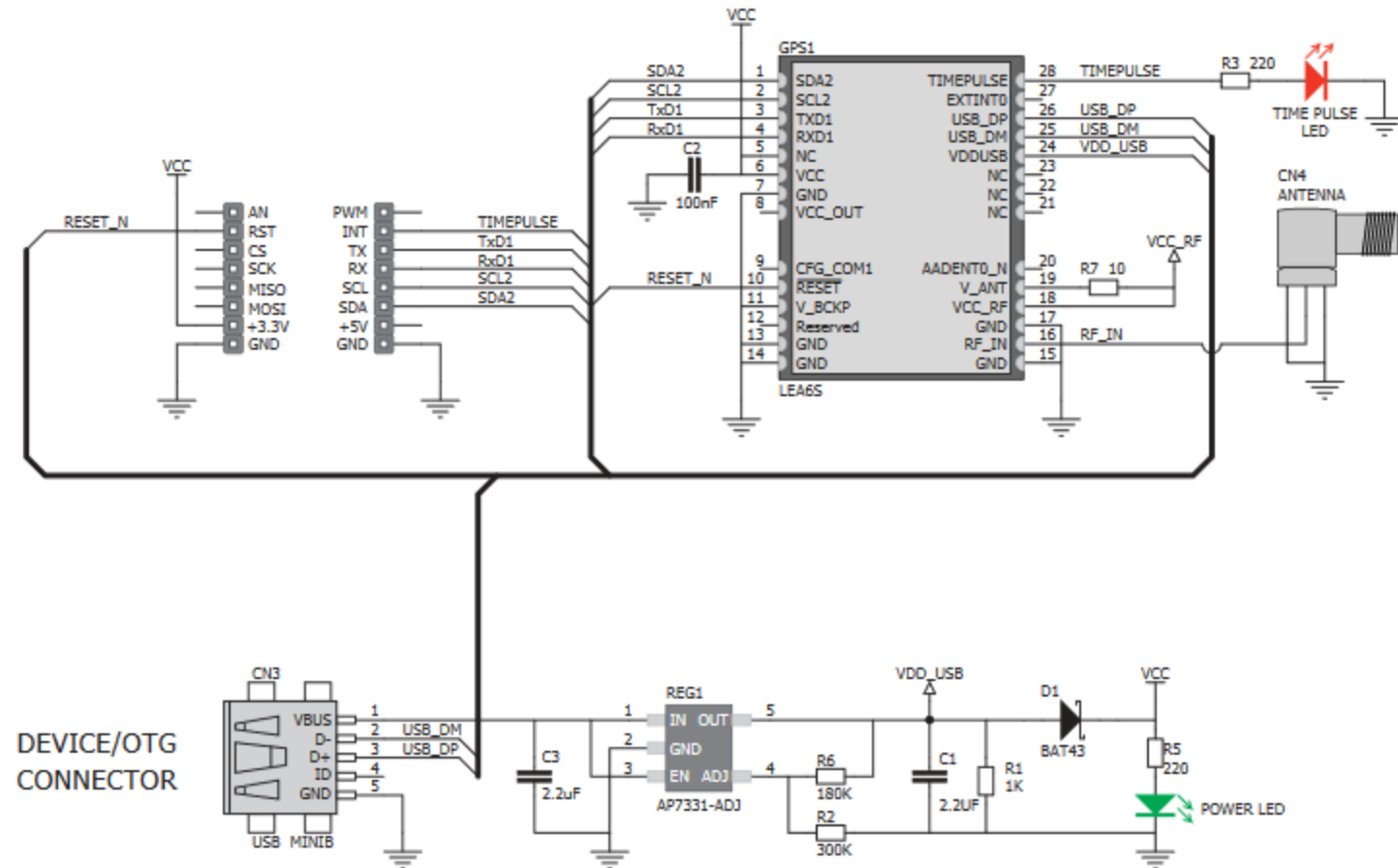
56:1 INS

MCC Setup



IoT Development Tools for PIC32

GPS click Project



IoT Development Tools for PIC32

GPS click Project

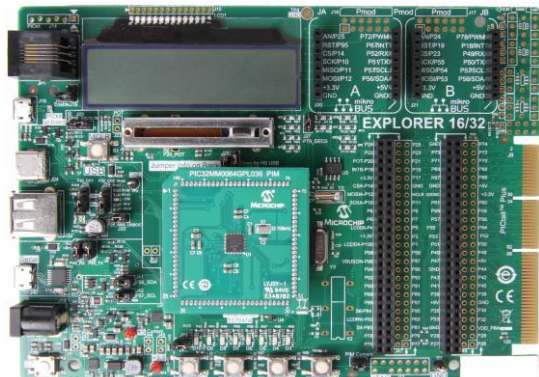
Projects x Files Services Resource Management [MCC]

explorer16-32_GPS

- Header Files
 - button_mapping.h
 - buttons.h
 - click_gps.h
 - lcd.h
- MCC Generated Files
 - exceptions.h
 - interrupt_manager.h
 - mcc.h
 - pin_manager.h
 - uart2.h
- mikrobus_b.h
- Important Files
- Linker Files
- Source Files
 - buttons.c
 - click_gps.c
 - lcd.c
 - lcd_printf.c
 - main.c
- MCC Generated Files
 - exceptions.c
 - interrupt_manager.c
 - mcc.c
 - pin_manager.c
 - uart2.c
- Libraries
- Loadables

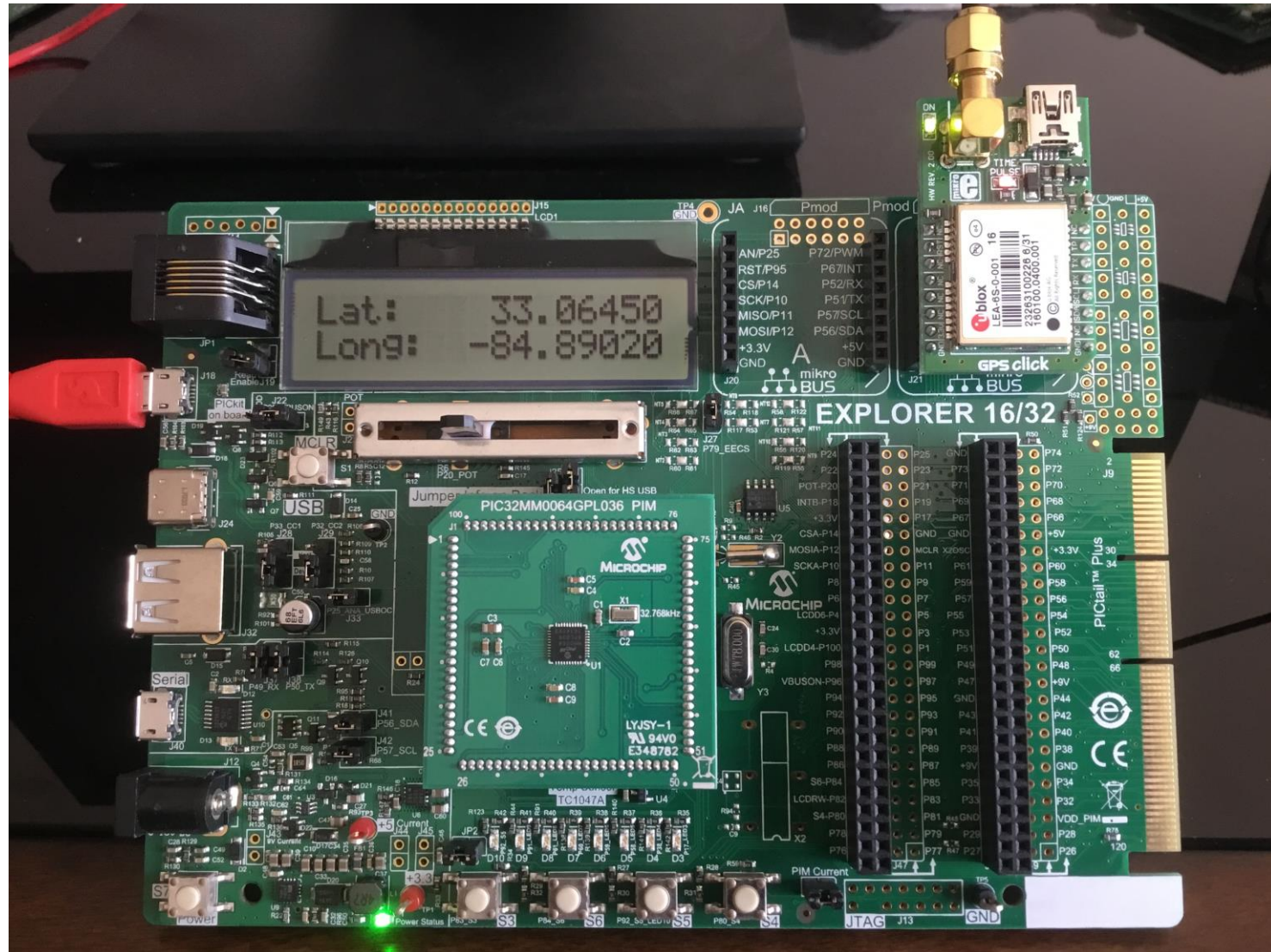
This PC > OS (C:) > Users > Public > cecPIC32toolsDay2Code > explorer16-32_GPS.X > bsp

Name	Date modified	Type	Size
adc.c	10/28/2016 11:33 ...	C Source File	6 KB
adc.h	10/28/2016 11:33 ...	C Include File	4 KB
button_mapping.h	7/25/2016 12:35 PM	C Include File	1 KB
buttons.c	10/28/2016 11:33 ...	C Source File	4 KB
buttons.h	10/28/2016 11:33 ...	C Include File	3 KB
hardware.txt	10/3/2016 6:30 PM	Text Document	4 KB
lcd.c	1/12/2018 3:46 PM	C Source File	17 KB
lcd.c~	1/11/2018 1:56 PM	C~ File	17 KB
lcd.h	10/3/2016 6:30 PM	C Include File	4 KB
lcd_printf.c	10/3/2016 6:30 PM	C Source File	1 KB
leds.c	10/28/2016 11:33 ...	C Source File	7 KB
leds.h	10/3/2016 6:30 PM	C Include File	5 KB
power.h	10/3/2016 6:30 PM	C Include File	2 KB
print_lcd.h	10/3/2016 6:30 PM	C Include File	4 KB
rtcc.c	1/11/2017 10:53 AM	C Source File	8 KB
rtcc.h	1/11/2017 10:53 AM	C Include File	2 KB
timer_1ms.c	10/28/2016 11:33 ...	C Source File	7 KB
timer_1ms.h	10/28/2016 11:33 ...	C Include File	3 KB



IoT Development Tools for PIC32

GPS click Project



IoT Development Tools for PIC32

Double click – Shake2Wake click Project

PIC32MX795F512L PIM (Plug-In Module) Table

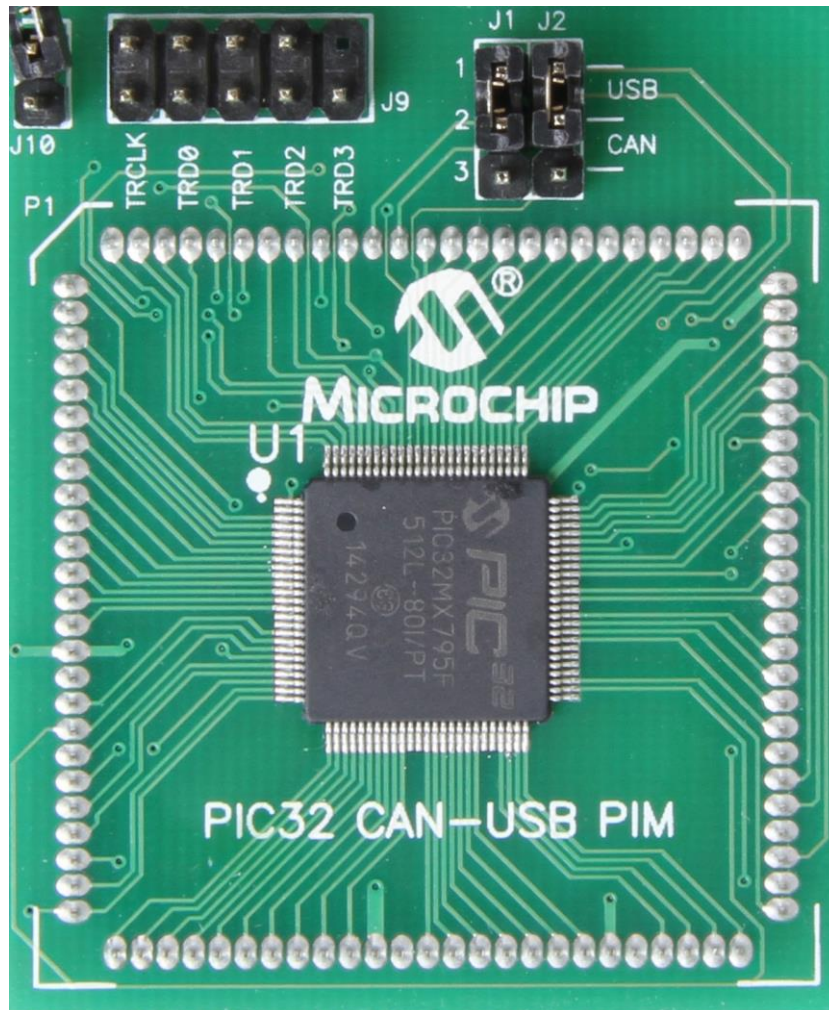


TABLE 1: 100-PIN TO 100-PIN PIM

Device Pin #	PIC32MX795F512L Functional Description	PIM Pin #
1	AERXERR/RG15	69
2	VDD	2
3	PMD5/RE5	3
4	PMD6/RE6	4
5	PMD7/RE7	5
6	T2CK/R1C1	6
7	T3CK/AC2TX/R2C2	7
8	T4CK/AC2RX/R3C3	8
9	T5CK/SD11/R4C4	9, 54
10	ECOL/SC2U6TX/U3RTS/PMA5/CN8/RG6	10
11	ECRS/SDA4/SDI2/U3RX/PMA4/CN9/RG7	11
12	ERXD0/AERXD0/ECRSD0/AECRSD0/SCL4/SDO2/U3TX/PMA3/CN10/RG8	12
13	MCLR	13
14	ERXCLK/AERXCLK/EREFCLK/AEREFCLK/SS2/U6RX/U3CTS/PMA2/CN11/RG9	14
15	VSS	15
16	VDD	16
17	TMS/RA0	17
18	AERXD0/INT1/RE8	18, 66
19	AERXD1/INT2/RE9	19
20	AN5/C1IN+/VBUSON/CN7/RB5	96
21	AN4/C1IN-/CN6/RB4	21
22	AN3/C2IN+/CN5/RB3	22
23	AN2/C2IN-/CN4/RB2	20
24	PGEC1/AN1/CN3/RB1	24
25	PGED1/AN0/CN2/RB0	25
26	PGEC2/AN6/OCFA/RB6	26
27	PGED2/AN7/RB7	27
28	VREF-/CVREF-/AERXD2/PMA7/RA9	28
29	VREF+/CVREF+/AERXD3/PMA6/RA10	29
30	AVDD	30
31	AVSS	31
32	AN8/C1OUT/RB8	32
33	AN9/C2OUT/RB9	33
34	AN10/CVREFOUT/PMA13/RB10	34

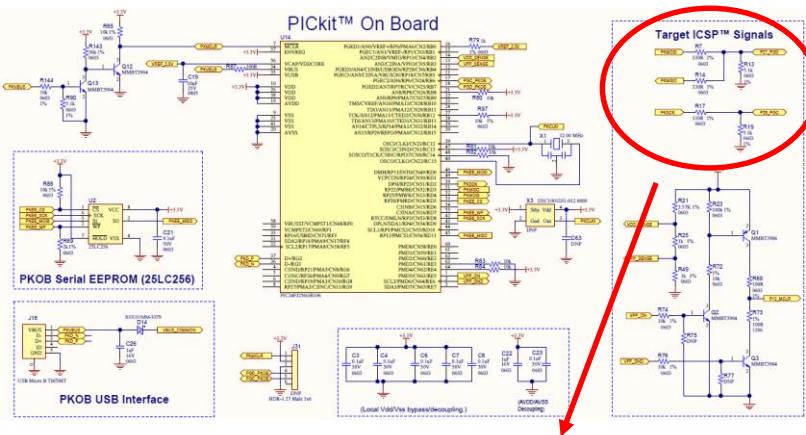
Device Pin #	PIC32MX795F512L Functional Description	PIM Pin #
35	AN11/ERXERR/AETXERR/PMA12/RB11	35
36	VSS	36
37	VDD	37
38	TCK/RA1	38
39	AC1TX/SC4/U5TX/U2RTS/R1F13	39
40	AC1RX/SS4/U5RX/U2CTS/R1F12	40
41	AN12/ERXD0/AECRS/PMA11/RB12	41
42	AN13/ERXD1/AECOL/PMA10/RB13	42
43	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	43
44	AN15/ERXD3/AETXD2/OCFB/PMALL/PMA0/CN12/RB15	44
45	VSS	45
46	VSS	46
47	AETXD0/SS3/U4RX/U1CTS/CN20/RD14	47
48	AETXD1/SC3/U4TX/U1RTS/CN21/RD15	48
49	SDA5/SDI4/U2RX/PMA9/CN17/R1F4	49
50	SCL5/SDO4/U2TX/PMA8/CN18/R1F5	50
51	USBID/R1F3	95
52	SDA3/SDI3/U1RX/R1F2	52
53	SCL3/SDO3/U1TX/R1F8	51
54	VBUS	1
55	VBUS	62
56	D-/RG3	89
57	D+/RG2	90
58	SCL2/RA2	58
59	SDA2/RA3	59
60	TDI/RA4	60
61	TDO/RA5	61
62	VDD	62
63	OSC1/CLK1/R1C12	63
64	OSC2/CLK0/R1C15	64
65	VSS	65
66	AETXCLK/SCL1/INT3/RA14	57
67	AETXEN/SDA1/INT4/RA15	56, 67
68	RTCC/EMDIO/AEMDIO/IC1/RD8	68

Presented by:

IoT Development Tools for PIC32

Double click – Shake2Wake click Project

Locate Programming Pins



Target ICSP™ Signals

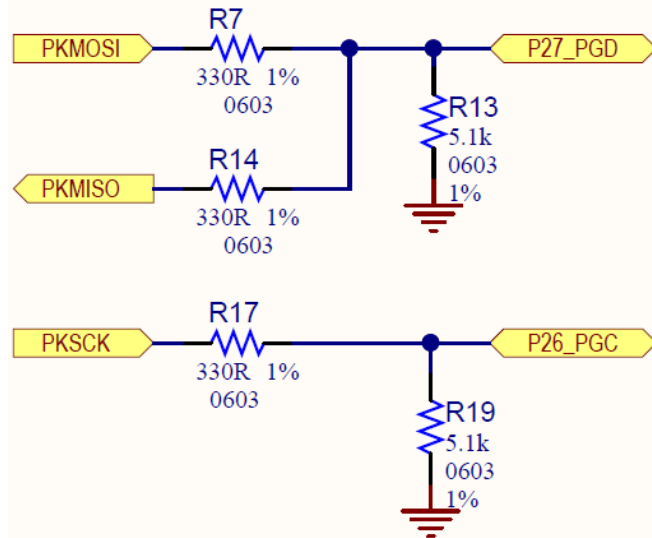


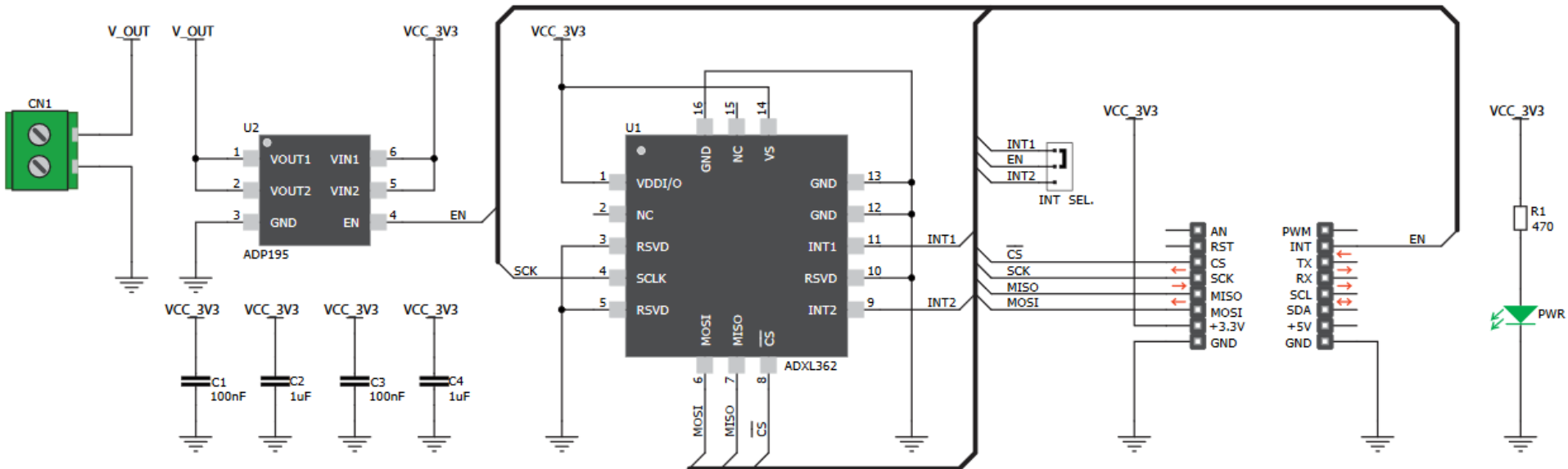
TABLE 1: 100-PIN TO 100-PIN PIM

Device Pin #	PIC32MX795F12L Functional Description	PIM Pin #
1	AERXERR/RG15	69
2	VDD	2
3	PMD5/RE5	3
4	PMD6/RE6	4
5	PMD7/RE7	5
6	T2CK/RC1	6
7	T3CK/AC2TX/RC2	7
8	T4CK/AC2RX/RC3	8
9	T5CK/SD11/RC4	9, 54
10	ECOL/SCCK2/U6TX/U3RTS/PMA5/CN8/RG6	10
11	ECRS/SDA4/SDI2/U3RX/PMA4/CN9/RG7	11
12	ERXDV/AERXDV/ECRS/DV/AECRS/DV/SCL4/SDO2/U3TX/PMA3/CN10/RG8	12
13	MCLR	13
14	ERXCLK/AERXCLK/EREFCLK/AEREFCLK/SS2/U6RX/U3CTS/PMA2/CN11/RG9	14
15	VSS	15
16	VDD	16
17	TMS/RA0	17
18	AERXD0/INT1/RE8	18, 66
19	AERXD1/INT2/RE9	19
20	AN5/C1IN+/VBUS0N/CN7/RB5	96
21	AN4/C1IN-/CN6/RB4	21
22	AN3/C2IN+/CN5/RB3	22
23	AN2/C2IN-/CN4/RB2	20
24	PGEC1/AN1/CN3/RB1	24
25	PGED1/AN0/CN2/RB0	25
26	PGEC2/AN6/OCFA/RB6	26
27	PGED2/AN7/RB7	27
28	VREF-/CVREF-/AERXD2/PMA7/RA9	28
29	VREF+/CVREF+/AERXD3/PMA6/RA10	29
30	AVDD	30
31	AVSS	31
32	AN8/C1OUT/RB8	32
33	AN9/C2OUT/RB9	33
34	AN10/CVREFOUT/PMA13/RB10	34

Device Pin #	PIC32MX795F12L Functional Description	PIM Pin #
35	AN11/ERXERR/AETXERR/PMA12/RB11	35
36	VSS	36
37	VDD	37
38	TCK/RA1	38
39	AC1TX/SCCK4/U5TX/U2RTS/RF13	39
40	AC1RX/SS4/U5RX/U2CTS/RF12	40
41	AN12/ERXD0/AECRS/PMA11/RB12	41
42	AN13/ERXD1/AECOL/PMA10/RB13	42
43	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	43
44	AN15/ERXD3/AETXD2/OCFB/PMALL/PMA0/CN12/RB15	44
45	VSS	45
46	VSS	46
47	AETXD0/SS3/U4RX/U1CTS/CN20/RD14	47
48	AETXD1/SCCK3/U4TX/U1RTS/CN21/RD15	48
49	SDA5/SDI4/U2RX/PMA9/CN17/RF4	49
50	SCL5/SDO4/U2TX/PMA8/CN18/RF5	50
51	USBID/RF3	95
52	SDA3/SDI3/U1RX/RF2	52
53	SCL3/SDO3/U1TX/RF8	51
54	VBUS	1
55	VBUS	62
56	D-/RG3	89
57	D+/RG2	90
58	SCL2/RA2	58
59	SDA2/RA3	59
60	TDI/RA4	60
61	TDO/RA5	61
62	VDD	62
63	OSC1/CLKI/RC12	63
64	OSC2/CLKO/RC15	64
65	VSS	65
66	AETXCLK/SCL1/INT3/RA14	57
67	AETXEN/SDA1/INT4/RA15	56, 67
68	RTCC/EMDIO/AEMDIO/IC1/RD8	68

IoT Development Tools for PIC32

Double click – Shake2Wake click Project



IoT Development Tools for PIC32

Double click – Shake2Wake click Project Locate SPI Pins

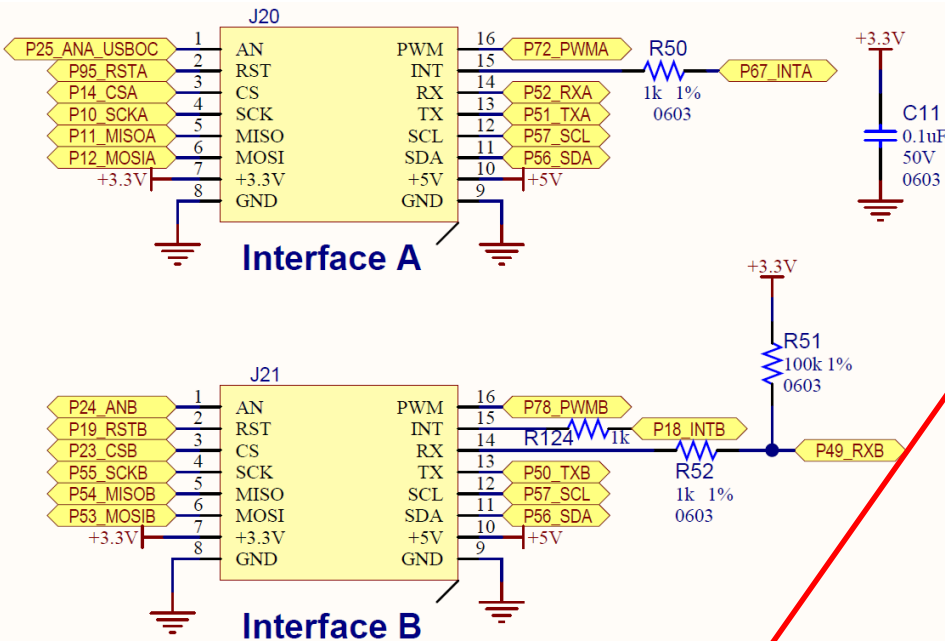


TABLE 1: 100-PIN TO 100-PIN PIM

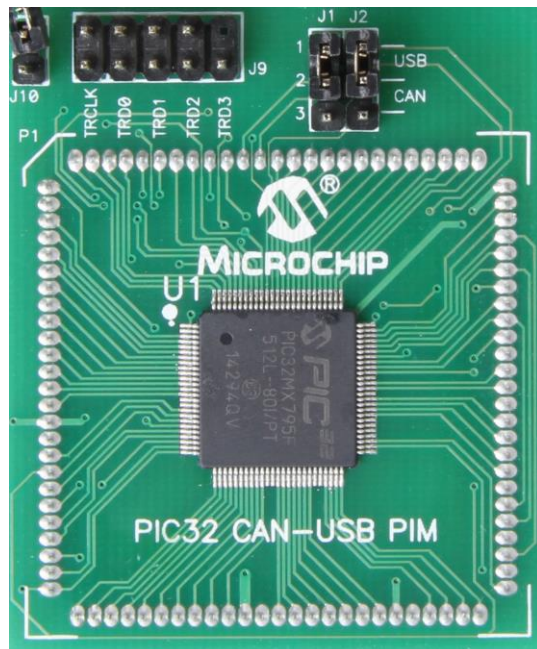
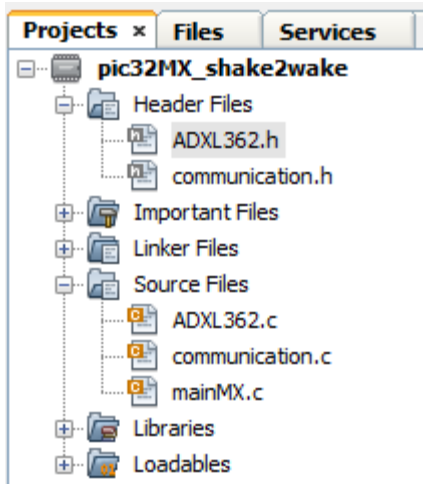
Device Pin #	PIC32MX795F512L Functional Description	PIM Pin #
1	AERXERR/RG15	69
2	VDD	2
3	PMD5/RE5	3
4	PMD6/RE6	4
5	PMD7/RE7	5
6	T2CK/R1C1	6
7	T3CK/AC2TX/R1C2	7
8	T4CK/AC2RX/R1C3	8
9	T5CK/SD11/R1C4	9, 54
10	ECOL/SCK2/U6TX/U3RTS/PMA5/CN8/RG6	10
11	ECRS/SDA4/SDI2/U3RX/PMA4/CN9/RG7	11
12	ERXDVI/AERXDVI/ECRSDVI/AECRSDVI/SCL4/SDO2/U3TX/PMA3/CN10/RG8	12
13	MCLR	13
14	ERXCLK/AERXCLK/EREFCLK/AEREFCLK/SS2/U6RX/U3CTS/PMA2/CN11/RG9	14
15	VSS	15
16	VDD	16
17	TMS/RA0	17
18	AERXD0/INT1/RE8	18, 66
19	AERXD1/INT2/RE9	19
20	AN5/C1IN+/BUSON/CN7/RB5	96
21	AN4/C1IN-/CN6/RB4	21
22	AN3/C2IN+/CN5/RB3	22
23	AN2/C2IN-/CN4/RB2	20
24	PGEC1/AN1/CN3/RB1	24
25	PGED1/AN0/CN2/RB0	25
26	PGEC2/AN6/OCFA/RB6	26
27	PGED2/AN7/RB7	27
28	VREF-/CVREF-/AERXD2/PMA7/RA9	28
29	VREF+/CVREF+/AERXD3/PMA6/RA10	29
30	AVDD	30
31	AVSS	31
32	AN8/C1OUT/RB8	32
33	AN9/C2OUT/RB9	33
34	AN10/CVREFOUT/PMA13/RB10	34

Device Pin #	PIC32MX795F512L Functional Description	PIM Pin #
35	AN11/ERXERR/AETXERR/PMA12/RB11	35
36	VSS	36
37	VDD	37
38	TCK/RA1	38
39	AC1TX/SCK4/U5TX/U2RTS/R1F13	39
40	AC1RX/SS4/U5RX/U2CTS/R1F12	40
41	AN12/ERXD0/AECRS/PMA11/RB12	41
42	AN13/ERXD1/AECOL/PMA10/RB13	42
43	AN14/ERXD2/AETXD3/PMALH/PMA1/RB14	43
44	AN15/ERXD3/AETXD2/OCFB/PMALL/PMA0/CN12/RB15	44
45	VSS	45
46	VSS	46
47	AETXD0/SS3/U4RX/U1CTS/CN20/RD14	47
48	AETXD1/SCK3/U4TX/U1RTS/CN21/RD15	48
49	SDA5/SDI4/U2RX/PMA9/CN17/R1F4	49
50	SCL5/SDO4/U2TX/PMA8/CN18/R1F5	50
51	USBID/R1F3	95
52	SDA3/SDI3/U1RX/R1F2	52
53	SCL3/SDO3/U1TX/R1F8	51
54	VBUS	1
55	VUS8	62
56	D-/RG3	89
57	D+/RG2	90
58	SCL2/RA2	58
59	SDA2/RA3	59
60	TDI/RA4	60
61	TDO/RA5	61
62	VDD	62
63	OSC1/CLK1/R1C12	63
64	OSC2/CLK0/R1C15	64
65	VSS	65
66	AETXCLK/SCL1/INT3/RA14	57
67	AETXEN/SDA1/INT4/RA15	56, 67
68	RTCC/EMDIO/AEMDIO/C1/RD8	68

10	ECOL/SCK2/U6TX/U3RTS/PMA5/CN8/RG6	10
11	ECRS/SDA4/SDI2/U3RX/PMA4/CN9/RG7	11
12	ERXDVI/AERXDVI/ECRSDVI/AECRSDVI/SCL4/SDO2/U3TX/PMA3/CN10/RG8	12

IoT Development Tools for PIC32

Double click – Shake2Wake click Project



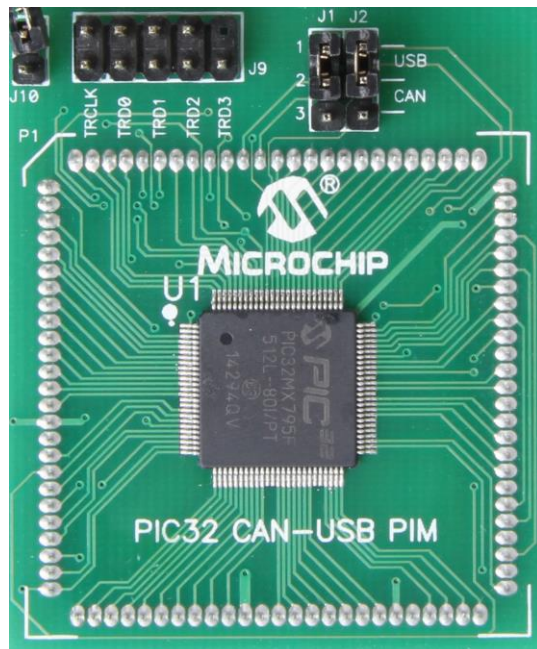
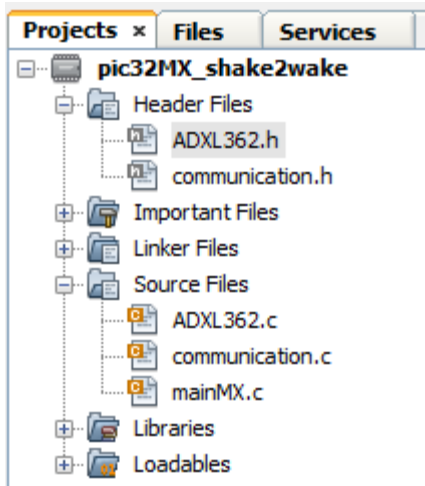
```

47 //*****
48 /** CLOCK MACROS
49 //*****
50 #define GetSystemClock()           8000000UL
51 #define GetPeripheralClock()       8000000UL
52 #define CoreTicksPerMs             (GetSystemClock() / 2000UL)
53 #define CoreTicksPerUs             (GetSystemClock() / 2000000UL)
54 //*****
55 /** mS DELAY
56 //*****
57 void ctDelaysms(uint16_t ms)
58 {
59     uint32_t msDelayTime, currentTickCnt;
60     currentTickCnt = _CP0_GET_COUNT();
61     msDelayTime = (CoreTicksPerMs * ms) + currentTickCnt;
62     while((_CP0_GET_COUNT()) < msDelayTime);
63 }
64 //*****
65 /** uS DELAY
66 //*****
67 void ctDelayus(uint16_t us)
68 {
69     uint32_t usDelayTime, currentTickCnt;
70     currentTickCnt = _CP0_GET_COUNT();
71     usDelayTime = (CoreTicksPerUs * us) + currentTickCnt;
72     while((_CP0_GET_COUNT()) < usDelayTime);
73 }

```

IoT Development Tools for PIC32

Double click – Shake2Wake click Project



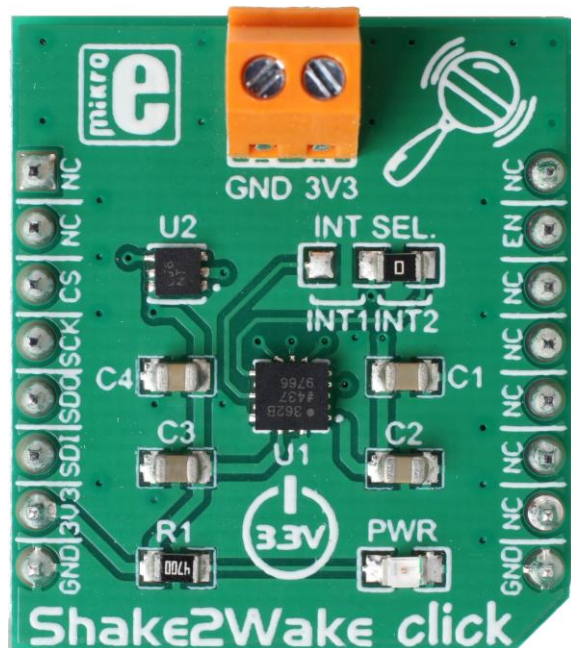
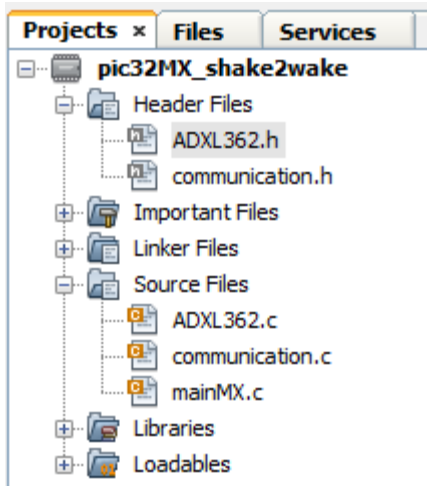
```

74 //*****
75 /** INITIALIZE FUNCTION
76 //*****
77 void initMX(void)
78 {
79     WORD i;
80     WORD timeouts;
81     // PIC32MX CPU Speed Optimizations (Cache/Wait States/Peripheral Bus Clks)
82     // On reset, and after c-startup:
83     // - Prefetch Buffer is disabled,
84     // - I Cache is disabled,
85     // - PFM wait States set to max setting (7 = too slow!!!)
86     // - Data Memory SRAM wait states set to max setting (1 = too slow!!!)
87     // PBCLK - already set to SYSCLK/1 via config settings
88     __builtin_disable_interrupts();
89     // Data Memory SRAM wait states: Default Setting = 1; set it to 0
90     BMXCONbits.BMXWSDRM = 0;
91     // Flash PM Wait States: MX Flash runs at 2 wait states @ 80 MHz
92     CHECONbits.PFMWS = 2;
93     // Prefetch-cache: Enable prefetch for cacheable PFM instructions
94     CHECONbits.PREFEN = 1;
95     // JTAG: Disable on PORTA
96     DDPCONbits.JTAGEN = 0;
97
98     TRISACLR = 0x0001;
99
100     // Set Interrupt Controller for multi-vector machineMode
101     INTCONSET = _INTCON_MVEC_MASK;
102
103     // set the CP0 status IE bit high to turn on interrupts globally
104     __builtin_enable_interrupts();
105 }

```


IoT Development Tools for PIC32

Double click – Shake2Wake click Project



```

107 //*****
108 //^ MAIN FUNCTION
109 //*****
110 void main(void)
111 {
112     initMX();
113     rc = ADXL362_Init();
114     if(rc == 0)
115     {
116         //set activity threshold 250 mg
117         ADXL362_SetRegisterValue(0x00FA,0x20,1);
118         ADXL362_SetRegisterValue(0x0000,0x21,1);
119
120         //set inactivity threshold 150 mg
121         ADXL362_SetRegisterValue(0x0096,0x23,1);
122         ADXL362_SetRegisterValue(0x0000,0x24,1);
123
124         //set inactivity timer 30 samples
125         ADXL362_SetRegisterValue(0x001E,0x25,1);
126
127         //configure motion detection in loop mode
128         //and enable referenced activity and inactivity
129         //detection
130         ADXL362_SetRegisterValue(0x003F,0x27,1);
131         //map the AWAKE bit to INT2
132         ADXL362_SetRegisterValue(0x0040,0x2B,1);
133
134         //begin the measurement in wake-up mode
135         ADXL362_SetRegisterValue(0x000A,0x2D,1);
136         do
137         {
138             ADXL362_GetRegisterValue(&regVal,ADXL362_REG_STATUS,1);
139             if(regVal & ADXL362_STATUS_AWAKE)
140             {
141                 LATASET = 0x0001;
142             }
143             else
144             {
145                 LATACLRL = 0x0001;
146             }
147         }while(1);
148     }
149 }

```

IoT Development Tools for PIC32

Nos Vemos Mañana

