Each pin has one configuration bit in the GPIOAMSEL register. We set this bit to connect the port pin to the ADC or analog comparator. For digital functions, each pin also has four bits in the GPIOPCTL register, which we set to specify the alternative function for that pin (0 means regular I/O port). Not every pin can be connected to every alternative function. See Table 6.1.

Pins PC3 – PC0 were left off Table 6.1 because these four pins are reserved for the JTAG debugger and should not be used for regular I/O. Notice, most alternate function modules (e.g., U0Rx) only exist on one pin (PA0). While other functions could be mapped to two or three pins (e.g., CAN0Rx could be mapped to one of the following: PB4, PE4, or PF0.)

For example, if we wished to use UART7 on pins PE0 and PE1, we would set bits 1,0 in the **GPIO_PORTE_DEN_R** register (enable digital), clear bits 1,0 in the **GPIO_PORTE_AMSEL_R** register (disable analog), set the PMCx bits in the **GPIO_PORTE_PCTL_R** register for PE0, PE1 to 0001 (enable UART functionality), and set bits 1,0 in the **GPIO_PORTE_AFSEL_R** register (enable alternate function). If we wished to sample an analog signal on PD0, we would set bit 0 in the alternate function select register, clear bit 0 in the digital enable register (disable digital), set bit 0 in the analog mode select register (enable analog), and activate one of the ADCs to sample channel 7.

IO	Ain	0	1	2	3	4	5	6	7	8	9	14
PA0		*Port*	U0Rx							CAN1Rx		
PA1		*Port*	U0Tx							CAN1Tx		
PA2		Port		SSI0Clk								
PA3		Port		SSI0Fss								
PA4		Port		SSI0Rx								
PA5		Port		SSI0Tx								
PA6		Port			I_2C1SCL		M1PWM2					
PA7		Port			I_2C1SDA		M1PWM3					
PB0		Port	U1Rx						T2CCP0			
PB1		Port	U1Tx						T2CCP1			
PB2		Port			I_2C0SCL				T3CCP0			

PB3		Port			I$_2$C0SDA				T3CCP1		
PB4	Ain10	Port		SSI2Clk		M0PWM2			T1CCP0	CAN0Rx	
PB5	Ain11	Port		SSI2Fss		M0PWM3			T1CCP1	CAN0Tx	
PB6		Port		SSI2Rx		M0PWM0			T0CCP0		
PB7		Port		SSI2Tx		M0PWM1			T0CCP1		
PC4	C1-	Port	U4Rx	U1Rx		M0PWM6		IDX1	WT0CCP0	U1RTS	
PC5	C1+	Port	U4Tx	U1Tx		M0PWM7		PhA1	WT0CCP1	U1CTS	
PC6	C0+	Port	U3Rx					PhB1	WT1CCP0	USB0epen	
PC7	C0-	Port	U3Tx						WT1CCP1	USB0pflt	
PD0	Ain7	Port	SSI3Clk	SSI1Clk	I$_2$C3SCL	M0PWM6	M1PWM0		WT2CCP0		
PD1	Ain6	Port	SSI3Fss	SSI1Fss	I$_2$C3SDA	M0PWM7	M1PWM1		WT2CCP1		
PD2	Ain5	Port	SSI3Rx	SSI1Rx		M0Fault0			WT3CCP0	USB0epen	
PD3	Ain4	Port	SSI3Tx	SSI1Tx				IDX0	WT3CCP1	USB0pflt	
PD4	*USB0DM*	*Port*	*U6Rx*						*WT4CCP0*		
PD5	*USB0DP*	*Port*	*U6Tx*						*WT4CCP1*		
PD6		Port	U2Rx			M0Fault0		PhA0	WT5CCP0		
PD7		Port	U2Tx					PhB0	WT5CCP1	NMI	
PE0	Ain3	Port	U7Rx								
PE1	Ain2	Port	U7Tx								
PE2	Ain1	Port									
PE3	Ain0	Port									
PE4	Ain9	Port	U5Rx		I$_2$C2SCL	M0PWM4	M1PWM2			CAN0Rx	
PE5	Ain8	Port	U5Tx		I$_2$C2SDA	M0PWM5	M1PWM3			CAN0Tx	
PF0		Port	U1RTS	SSI1Rx	CAN0Rx		M1PWM4	PhA0	T0CCP0	NMI	C0o	
PF1		Port	U1CTS	SSI1Tx			M1PWM5	PhB0	T0CCP1		C1o	TRD1
PF2		Port		SSI1Clk		M0Fault0	M1PWM6		T1CCP0			TRD0
PF3		Port		SSI1Fss	CAN0Tx		M1PWM7		T1CCP1			TRCLK

PF4		Port					M1Fault0	IDX0	T2CCP0	USB0epen	

Table 6.1. PMCx bits in the GPIOPCTL register on the LM4F/TM4C specify alternate functions. *PD4* and *PD5* are hardwired to the USB device. *PA0* and *PA1* are hardwired to the serial port. PWM not on LM4F120.

The LaunchPad evaluation board (Figure 6.2) is a low-cost development board available as part number EK-LM4F120XL and EK-TM4C123GXL from https://estore.ti.com/ (https://estore.ti.com/) and in the US from regular electronic distributors like Digikey, Mouser, Arrow, Newark, and Avnet. For detailed instruction for obtaining the lab kit, refer to http://users.ece.utexas.edu/~valvano/edX/ (http://users.ece.utexas.edu/%7Evalvano/edX/). The microcontroller board provides an integrated In-Circuit Debug Interface (ICDI), which allows programming and debugging of the onboard LM4F120 or TM4C123 microcontroller. One USB cable is used by the debugger (ICDI), and the other USB allows the user to develop USB applications (device). The user can select board power to come from either the debugger (ICDI) or the USB device (device) by setting the Power selection switch.
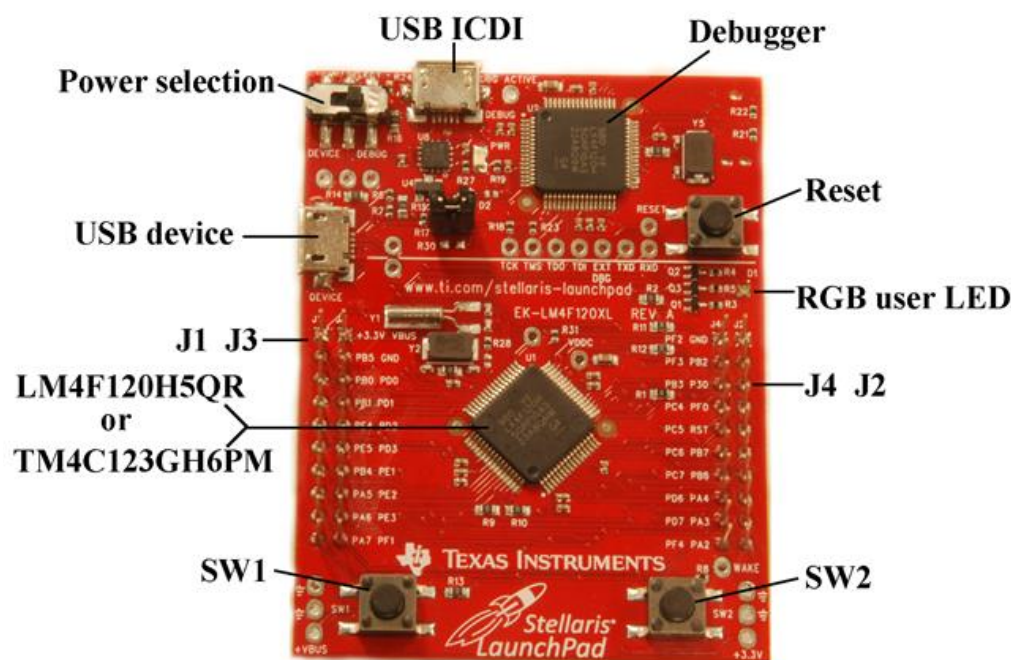
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Figure 6.2. Tiva LaunchPad based on the LM4F120H5QR or TM4C123GH6PM.

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