



MICROCHIP PIC16F631/677/685/687/689/690

20-Pin Flash-Based, 8-Bit CMOS Microcontrollers with nanoWatt Technology

High-Performance RISC CPU:

- Only 35 Instructions to Learn:
 - All single-cycle instructions except branches
- Operating Speed:
 - DC – 20 MHz oscillator/clock input
 - DC – 200 ns instruction cycle
- Interrupt Capability
- 8-Level Deep Hardware Stack
- Direct, Indirect and Relative Addressing modes

Special Microcontroller Features:

- Precision Internal Oscillator:
 - Factory calibrated to $\pm 1\%$
 - Software selectable frequency range of 8 MHz to 32 kHz
 - Software tunable
 - Two-Speed Start-up mode
 - Crystal fail detect for critical applications
 - Clock mode switching during operation for power savings
- Power-Saving Sleep mode
- Wide Operating Voltage Range (2.0V-5.5V)
- Industrial and Extended Temperature Range
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Brown-out Reset (BOR) with Software Control Option
- Enhanced Low-Current Watchdog Timer (WDT) with On-Chip Oscillator (Software selectable nominal 268 Seconds with Full Prescaler) with Software Enable
- Multiplexed Master Clear/Input Pin
- Programmable Code Protection
- High Endurance Flash/EEPROM Cell:
 - 100,000 write Flash endurance
 - 1,000,000 write EEPROM endurance
 - Flash/Data EEPROM retention: > 40 years
- Enhanced USART Module:
 - Supports RS-485, RS-232 and LIN 2.0
 - Auto-Baud Detect
 - Auto-wake-up on Start bit

Low-Power Features:

- **Standby Current:**
 - 50 nA @ 2.0V, typical
- **Operating Current:**
 - 11 μ A @ 32 kHz, 2.0V, typical
 - 220 μ A @ 4 MHz, 2.0V, typical
- **Watchdog Timer Current:**
 - <1 μ A @ 2.0V, typical

Peripheral Features:

- 17 I/O Pins and 1 Input-Only Pin:
 - High current source/sink for direct LED drive
 - Interrupt-on-Change pin
 - Individually programmable weak pull-ups
 - Ultra Low-Power Wake-up (ULPWU)
- Analog Comparator Module with:
 - Two analog comparators
 - Programmable on-chip voltage reference (CVREF) module (% of VDD)
 - Comparator inputs and outputs externally accessible
 - SR Latch mode
 - Timer 1 Gate Sync Latch
 - Fixed 0.6V VREF
- A/D Converter:
 - 10-bit resolution and 12 channels
- Timer0: 8-bit Timer/Counter with 8-bit Programmable Prescaler
- Enhanced Timer1:
 - 16-bit timer/counter with prescaler
 - External Timer1 Gate (count enable)
 - Option to use OSC1 and OSC2 in LP mode as Timer1 oscillator if INTOSC mode selected
- Timer2: 8-bit Timer/Counter with 8-bit Period Register, Prescaler and Postscaler
- Enhanced Capture, Compare, PWM+ Module:
 - 16-bit Capture, max resolution 12.5 ns
 - Compare, max resolution 200 ns
 - 10-bit PWM with 1, 2 or 4 output channels, programmable "dead time", max frequency 20 kHz
 - PWM output steering control
- Synchronous Serial Port (SSP):
 - SPI mode (Master and Slave)
- I²C™ (Master/Slave modes):
 - I²C™ address mask
- In-Circuit Serial Programming™ (ICSP™) via Two Pins

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Device	Program Memory	Data Memory		I/O	10-bit A/D (ch)	Comparators	Timers 8/16-bit	SSP	ECCP+	EUSART
	Flash (words)	SRAM (bytes)	EEPROM (bytes)							
PIC16F631	1024	64	128	18	—	2	1/1	No	No	No
PIC16F677	2048	128	256	18	12	2	1/1	Yes	No	No
PIC16F685	4096	256	256	18	12	2	2/1	No	Yes	No
PIC16F687	2048	128	256	18	12	2	1/1	Yes	No	Yes
PIC16F689	4096	256	256	18	12	2	1/1	Yes	No	Yes
PIC16F690	4096	256	256	18	12	2	2/1	Yes	Yes	Yes

PIC16F631 Pin Diagram

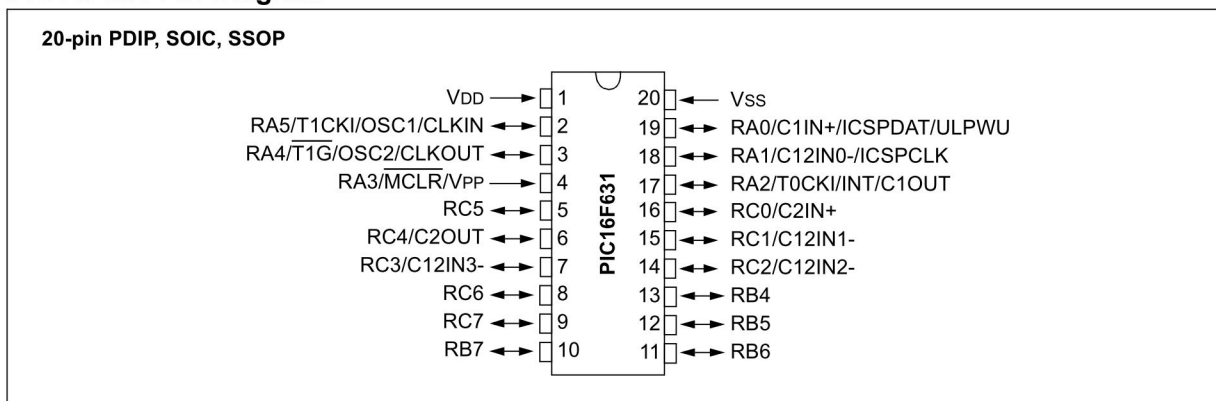


TABLE 1: PIC16F631 PIN SUMMARY

I/O	Pin	Analog	Comparators	Timers	Interrupt	Pull-up	Basic
RA0	19	AN0/ULPWU	C1IN+	—	IOC	Y	ICSPDAT
RA1	18	AN1	C12IN0-	—	IOC	Y	ICSPCLK
RA2	17	—	C1OUT	T0CKI	IOC/INT	Y	—
RA3	4	—	—	—	IOC	Y ⁽¹⁾	MCLR/VPP
RA4	3	—	—	T1G	IOC	Y	OSC2/CLKOUT
RA5	2	—	—	T1CKI	IOC	Y	OSC1/CLKIN
RB4	13	—	—	—	IOC	Y	—
RB5	12	—	—	—	IOC	Y	—
RB6	11	—	—	—	IOC	Y	—
RB7	10	—	—	—	IOC	Y	—
RC0	16	AN4	C2IN+	—	—	—	—
RC1	15	AN5	C12IN1-	—	—	—	—
RC2	14	AN6	C12IN2-	—	—	—	—
RC3	7	AN7	C12IN3-	—	—	—	—
RC4	6	—	C2OUT	—	—	—	—
RC5	5	—	—	—	—	—	—
RC6	8	—	—	—	—	—	—
RC7	9	—	—	—	—	—	—
—	1	—	—	—	—	—	VDD
—	20	—	—	—	—	—	VSS

Note 1: Pull-up enabled only with external MCLR configuration.

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PIC16F685 Pin Diagram

20-pin PDIP, SOIC, SSOP

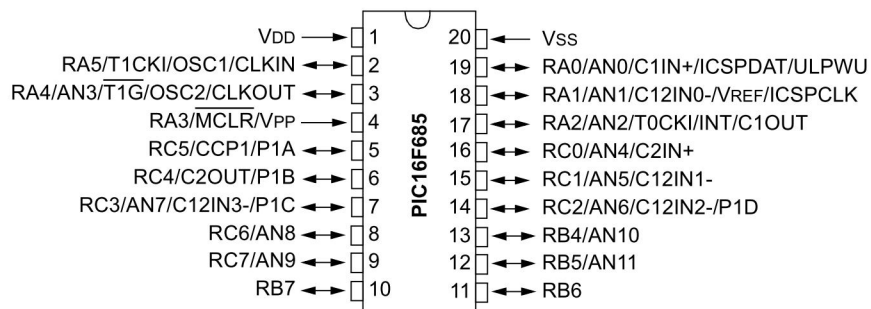


TABLE 3: PIC16F685 PIN SUMMARY

I/O	Pin	Analog	Comparators	Timers	ECCP	Interrupt	Pull-up	Basic
RA0	19	AN0/ULPWU	C1IN+	—	—	IOC	Y	ICSPDAT
RA1	18	AN1/VREF	C12IN0-	—	—	IOC	Y	ICSPCLK
RA2	17	AN2	C1OUT	T0CKI	—	IOC/INT	Y	—
RA3	4	—	—	—	—	IOC	Y ⁽¹⁾	MCLR/VPP
RA4	3	AN3	—	T1G	—	IOC	Y	OSC2/CLKOUT
RA5	2	—	—	T1CKI	—	IOC	Y	OSC1/CLKIN
RB4	13	AN10	—	—	—	IOC	Y	—
RB5	12	AN11	—	—	—	IOC	Y	—
RB6	11	—	—	—	—	IOC	Y	—
RB7	10	—	—	—	—	IOC	Y	—
RC0	16	AN4	C2IN+	—	—	—	—	—
RC1	15	AN5	C12IN1-	—	—	—	—	—
RC2	14	AN6	C12IN2-	—	P1D	—	—	—
RC3	7	AN7	C12IN3-	—	P1C	—	—	—
RC4	6	—	C2OUT	—	P1B	—	—	—
RC5	5	—	—	—	CCP1/P1A	—	—	—
RC6	8	AN8	—	—	—	—	—	—
RC7	9	AN9	—	—	—	—	—	—
—	1	—	—	—	—	—	—	VDD
—	20	—	—	—	—	—	—	VSS

Note 1: Pull-up activated only with external MCLR configuration.