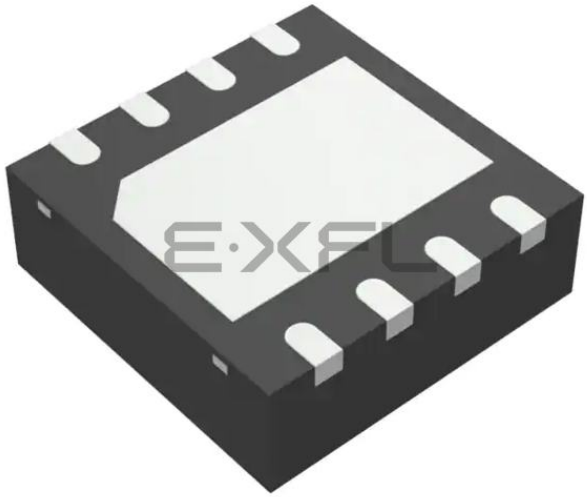

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Details	
Product Status	Obsolete
Core Processor	PIC
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Number of I/O	5
Program Memory Size	1.75KB (1K x 14)
Program Memory Type	FLASH
EEPROM Size	128 x 8
RAM Size	64 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	8-VDFN Exposed Pad
Supplier Device Package	8-DFN-S (6x5)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic12f635-e-mf

20-Pin Diagram

SSOP

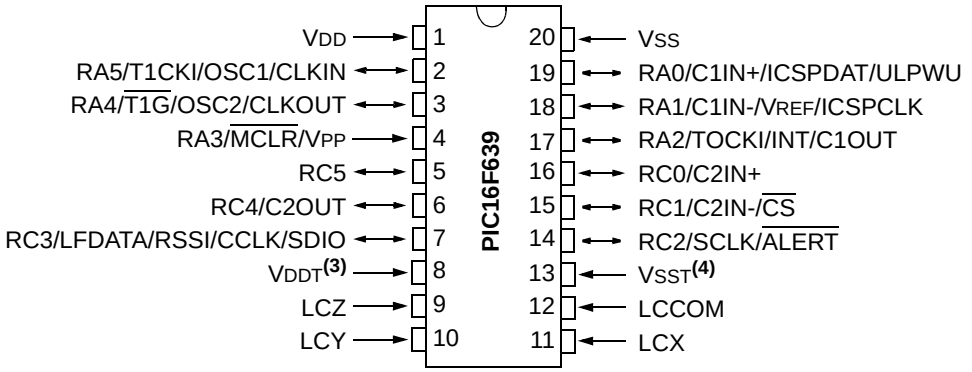


TABLE 4: 20-PIN SUMMARY

I/O	Pin	Analog Front-End	Comparators	Timer	Interrupts	Pull-ups	Basic
RA0	19	—	C1IN+	—	IOC	Y	ICSPDAT/ULPWU
RA1	18	—	C1IN-	—	IOC	Y	VREF/ICSPCLK
RA2	17	—	C1OUT	T0CKI	INT/IOC	Y	—
RA3(1)	4	—	—	—	IOC	Y(2)	MCLR/VPP
RA4	3	—	—	T1G	IOC	Y	OSC2/CLKOUT
RA5	2	—	—	T1CKI	IOC	Y	OSC1/CLKIN
RC0	16	—	C2IN+	—	—	—	—
RC1	15	—	C2IN-	—	—	—	CS
RC2	14	ALERT	—	—	—	—	SCLK
RC3	7	LFDATA/RSSI	—	—	—	—	CCLK/SDIO
RC4	6	—	C2OUT	—	—	—	—
RC5	5	—	—	—	—	—	—
—	8	—	—	—	—	—	VDDT(3)
—	13	—	—	—	—	—	VSST(4)
—	11	LCX	—	—	—	—	—
—	10	LCY	—	—	—	—	—
—	9	LCZ	—	—	—	—	—
—	12	LCCOM	—	—	—	—	—
—	1	—	—	—	—	—	VDD
—	20	—	—	—	—	—	VSS

Note 1: Input only.

2: Only when pin is configured for external MCLR.

3: VDDT is the supply voltage of the Analog Front-End section (PIC16F639 only). VDDT is treated as VDD in this document unless otherwise stated.

4: VSST is the ground reference voltage of the Analog Front-End section (PIC16F639 only). VSST is treated as VSS in this document unless otherwise stated.

TABLE 1-3: PIC16F639 PINOUT DESCRIPTIONS

Name	Function	Input Type	Output Type	Description
LCCOM	LCCOM	AN	—	Common reference for analog inputs.
LCX	LCX	AN	—	125 kHz analog X channel input.
LCY	LCY	AN	—	125 kHz analog Y channel input.
LCZ	LCZ	AN	—	125 kHz analog Z channel input.
RA0/C1IN+/ICSPDAT/ULPWU	RA0	TTL	—	General purpose I/O. Individually controlled interrupt-on-change. Individually enabled pull-up/pull-down. Selectable Ultra Low-Power Wake-up pin.
	C1IN+	AN	—	Comparator1 input – positive.
	ICSPDAT	TTL	CMOS	Serial Programming Data IO.
	ULPWU	AN	—	Ultra Low-Power Wake-up input.
RA1/C1IN-/VREF/ICSPCLK	RA1	TTL	CMOS	General purpose I/O. Individually controlled interrupt-on-change. Individually enabled pull-up/pull-down.
	C1IN-	AN	—	Comparator1 input – negative.
	VREF	AN	—	External voltage reference
	ICSPCLK	ST	—	Serial Programming Clock.
RA2/T0CKI/INT/C1OUT	RA2	ST	CMOS	General purpose I/O. Individually controlled interrupt-on-change. Individually enabled pull-up/pull-down.
	T0CKI	ST	—	External clock for Timer0.
	INT	ST	—	External Interrupt.
	C1OUT	—	CMOS	Comparator1 output.
RA3/$\overline{\text{MCLR}}$/VPP	RA3	TTL	—	General purpose input. Individually controlled interrupt-on-change.
	$\overline{\text{MCLR}}$	ST	—	Master Clear Reset. Pull-up enabled when configured as $\overline{\text{MCLR}}$.
	VPP	HV	—	Programming voltage.
RA4/$\overline{\text{T1G}}$/OSC2/CLKOUT	RA4	TTL	CMOS	General purpose I/O. Individually controlled interrupt-on-change. Individually enabled pull-up/pull-down.
	$\overline{\text{T1G}}$	ST	—	Timer1 gate.
	OSC2	—	XTAL	XTAL connection.
	CLKOUT	—	CMOS	TOSC reference clock.
RA5/T1CKI/OSC1/CLKIN	RA5	TTL	CMOS	General purpose I/O. Individually controlled interrupt-on-change. Individually enabled pull-up/pull-down.
	T1CKI	ST	—	Timer1 clock.
	OSC1	XTAL	—	XTAL connection.
	CLKIN	ST	—	TOSC/4 reference clock.
RC0/C2IN+	RC0	TTL	CMOS	General purpose I/O.
	C2IN+	AN	—	Comparator1 input – positive.
RC1/C2IN-/$\overline{\text{CS}}$	RC1	TTL	CMOS	General purpose I/O.
	C2IN-	AN	—	Comparator1 input – negative.
	$\overline{\text{CS}}$	TTL	—	Chip select input for SPI communication with internal pull-up resistor.
RC2/SCLK/$\overline{\text{ALERT}}$	RC2	TTL	CMOS	General purpose I/O.
	SCLK	TTL	—	Digital clock input for SPI communication.
	$\overline{\text{ALERT}}$	—	OD	Output with internal pull-up resistor for AFE error signal.

Legend: AN = Analog input or output; CMOS = CMOS compatible input or output; D = Direct
HV = High Voltage; ST = Schmitt Trigger input with CMOS levels; OD = Open Drain
TTL = TTL compatible input; XTAL = Crystal

TABLE 1-3: PIC16F639 PINOUT DESCRIPTIONS (CONTINUED)

Name	Function	Input Type	Output Type	Description
RC3/LFDATA/RSSI/CCLK/SDO	RC3	TTL	CMOS	General purpose I/O.
	LFDATA	—	CMOS	Digital output representation of analog input signal to LC pins.
	RSSI	—	Current	Received signal strength indicator. Analog current that is proportional to input amplitude.
	CCLK	—	—	Carrier clock output.
	SDIO	TTL	CMOS	Input/Output for SPI communication.
RC4/C2OUT	RC4	TTL	CMOS	General purpose I/O.
	C2OUT	—	CMOS	Comparator2 output.
RC5	RC5	TTL	CMOS	General purpose I/O.
VDDT	VDDT	D	—	Power supply for Analog Front-End. In this document, VDDT is treated the same as VDD, unless otherwise stated.
VSST	VSST	D	—	Ground reference for Analog Front-End. In this document, VSST is treated the same as VSS, unless otherwise stated.
VDD	VDD	D	—	Power supply for microcontroller.
VSS	VSS	D	—	Ground reference for microcontroller.

Legend: AN = Analog input or output; CMOS = CMOS compatible input or output; D = Direct
HV = High Voltage; ST = Schmitt Trigger input with CMOS levels; OD = Open Drain
TTL = TTL compatible input; XTAL = Crystal

TABLE 2-1: PIC12F635 SPECIAL FUNCTION REGISTERS SUMMARY BANK 0

Addr	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR/BOR/ WUR	Page
Bank 0											
00h	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								xxxx xxxx	32,137
01h	TMR0	Timer0 Module Register								xxxx xxxx	61,137
02h	PCL	Program Counter's (PC) Least Significant Byte								0000 0000	32,137
03h	STATUS	IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0001 1xxx	26,137
04h	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	32,137
05h	GPIO	—	—	GP5	GP4	GP3	GP2	GP1	GP0	--xx xx00	47,137
06h	—	Unimplemented								—	—
07h	—	Unimplemented								—	—
08h	—	Unimplemented								—	—
09h	—	Unimplemented								—	—
0Ah	PCLATH	—	—	—	Write Buffer for upper 5 bits of Program Counter					---0 0000	32,137
0Bh	INTCON	GIE	PEIE	T0IE	INTE	RAIE	T0IF	INTF	RAIF(2)	0000 000x	28,137
0Ch	PIR1	EEIF	LVDIF	CRIF	—	C1IF	OSFIF	—	TMR1IF	000- 00-0	30,137
0Dh	—	Unimplemented								—	—
0Eh	TMR1L	Holding Register for the Least Significant Byte of the 16-bit TMR1								xxxx xxxx	64,137
0Fh	TMR1H	Holding Register for the Most Significant Byte of the 16-bit TMR1								xxxx xxxx	64,137
10h	T1CON	T1GINV	TMR1GE	T1CKPS1	T1CKPS0	T1OSCEN	$\overline{T1SYNC}$	TMR1CS	TMR1ON	0000 0000	68,137
11h	—	Unimplemented								—	—
12h	—	Unimplemented								—	—
13h	—	Unimplemented								—	—
14h	—	Unimplemented								—	—
15h	—	Unimplemented								—	—
16h	—	Unimplemented								—	—
17h	—	Unimplemented								—	—
18h	WDTCON	—	—	—	WDTPS3	WDTPS2	WDTPS1	WDTPS0	SWDTEN	---0 1000	144,137
19h	CMCON0	—	COUT	—	CINV	CIS	CM2	CM1	CM0	-0-0 0000	79,137
1Ah	CMCON1	—	—	—	—	—	—	T1GSS	CMSYNC	---- --10	82,137
1Bh	—	Unimplemented								—	—
1Ch	—	Unimplemented								—	—
1Dh	—	Unimplemented								—	—
1Eh	—	Unimplemented								—	—
1Fh	—	Unimplemented								—	—

Legend: – = Unimplemented locations read as '0', u = unchanged, x = unknown, q = value depends on condition, shaded = unimplemented

Note 1: Other (non Power-up) Resets include $\overline{MCLR}$ Reset and Watchdog Timer Reset during normal operation.

2: $\overline{MCLR}$ and WDT Reset do not affect the previous value data latch. The RAIF bit will be cleared upon Reset but will set again if the mismatch exists.

2.2.2.1 STATUS Register

The STATUS register, shown in Register 2-1, contains:

- the arithmetic status of the ALU
- the Reset status
- the bank select bits for data memory (GPR and SFR)

The STATUS register can be the destination for any instruction, like any other register. If the STATUS register is the destination for an instruction that affects the Z, DC or C bits, then the write to these three bits is disabled. These bits are set or cleared according to the device logic. Furthermore, the $\overline{TO}$ and $\overline{PD}$ bits are not writable. Therefore, the result of an instruction with the STATUS register as destination may be different than intended.

For example, `CLRF STATUS,` will clear the upper three bits and set the Z bit. This leaves the STATUS register as '`000u u1uu`' (where `u` = unchanged).

It is recommended, therefore, that only `BCF, BSF, SWAPF` and `MOVWF` instructions are used to alter the STATUS register, because these instructions do not affect any Status bits. For other instructions not affecting any Status bits, see **Section 13.0 "Instruction Set Summary"**

Note 1: The C and DC bits operate as a $\overline{Borrow}$ and Digit $\overline{Borrow}$ out bit, respectively, in subtraction.

REGISTER 2-1: STATUS: STATUS REGISTER

R/W-0	R/W-0	R/W-0	R-1	R-1	R/W-x	R/W-x	R/W-x
IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC(1)	C(1)
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 7 **IRP:** Register Bank Select bit (used for indirect addressing)
`1` = Bank 2, 3 (100h-1FFh)
`0` = Bank 0, 1 (00h-FFh)

bit 6-5 **RP<1:0>:** Register Bank Select bits (used for direct addressing)
`00` = Bank 0 (00h-7Fh)
`01` = Bank 1 (80h-FFh)
`10` = Bank 2 (100h-17Fh)
`11` = Bank 3 (180h-1FFh)

bit 4 **$\overline{TO}$:** Time-out bit
`1` = After power-up, `CLRWDT` instruction or `SLEEP` instruction
`0` = A WDT time-out occurred

bit 3 **$\overline{PD}$:** Power-down bit
`1` = After power-up or by the `CLRWDT` instruction
`0` = By execution of the `SLEEP` instruction

bit 2 **Z:** Zero bit
`1` = The result of an arithmetic or logic operation is zero
`0` = The result of an arithmetic or logic operation is not zero

bit 1 **DC:** Digit Carry/$\overline{Borrow}$ bit (`ADDWF, ADDLW, SUBLW, SUBWF` instructions)(1)
`1` = A carry-out from the 4th low-order bit of the result occurred
`0` = No carry-out from the 4th low-order bit of the result

bit 0 **C:** Carry/$\overline{Borrow}$ bit(1) (`ADDWF, ADDLW, SUBLW, SUBWF` instructions)(1)
`1` = A carry-out from the Most Significant bit of the result occurred
`0` = No carry-out from the Most Significant bit of the result occurred

Note 1: For $\overline{Borrow}$, the polarity is reversed. A subtraction is executed by adding the two's complement of the second operand. For rotate (`RRF, RLF`) instructions, this bit is loaded with either the high-order or low-order bit of the source register.

3.6 Clock Switching

The system clock source can be switched between external and internal clock sources via software using the System Clock Select (SCS) bit of the OSCCON register.

3.6.1 SYSTEM CLOCK SELECT (SCS) BIT

The System Clock Select (SCS) bit of the OSCCON register selects the system clock source that is used for the CPU and peripherals.

- When the SCS bit of the OSCCON register = 0, the system clock source is determined by configuration of the FOSC<2:0> bits in the Configuration Word register (CONFIG).
- When the SCS bit of the OSCCON register = 1, the system clock source is chosen by the internal oscillator frequency selected by the IRCF<2:0> bits of the OSCCON register. After a Reset, the SCS bit of the OSCCON register is always cleared.

Note:	Any automatic clock switch, which may occur from Two-Speed Start-up or Fail-Safe Clock Monitor, does not update the SCS bit of the OSCCON register. The user can monitor the OSTS bit of the OSCCON register to determine the current system clock source.

3.6.2 OSCILLATOR START-UP TIME-OUT STATUS (OSTS) BIT

The Oscillator Start-up Time-out Status (OSTS) bit of the OSCCON register indicates whether the system clock is running from the external clock source, as defined by the FOSC<2:0> bits in the Configuration Word register (CONFIG), or from the internal clock source. In particular, OSTS indicates that the Oscillator Start-up Timer (OST) has timed out for LP, XT or HS modes.

3.7 Two-Speed Clock Start-up Mode

Two-Speed Start-up mode provides additional power savings by minimizing the latency between external oscillator start-up and code execution. In applications that make heavy use of the Sleep mode, Two-Speed Start-up will remove the external oscillator start-up time from the time spent awake and can reduce the overall power consumption of the device.

This mode allows the application to wake-up from Sleep, perform a few instructions using the INTOSC as the clock source and go back to Sleep without waiting for the primary oscillator to become stable.

Note:	Executing a SLEEP instruction will abort the oscillator start-up time and will cause the OSTS bit of the OSCCON register to remain clear.

When the Oscillator module is configured for LP, XT or HS modes, the Oscillator Start-up Timer (OST) is enabled (see **Section 3.4.1 "Oscillator Start-up Timer (OST)"**). The OST will suspend program execution until 1024 oscillations are counted. Two-Speed Start-up mode minimizes the delay in code execution by operating from the internal oscillator as the OST is counting. When the OST count reaches 1024 and the OSTS bit of the OSCCON register is set, program execution switches to the external oscillator.

3.7.1 TWO-SPEED START-UP MODE CONFIGURATION

Two-Speed Start-up mode is configured by the following settings:

- IESO (of the Configuration Word register) = 1; Internal/External Switchover bit (Two-Speed Start-up mode enabled).
- SCS (of the OSCCON register) = 0.
- FOSC<2:0> bits in the Configuration Word register (CONFIG) configured for LP, XT or HS mode.

Two-Speed Start-up mode is entered after:

- Power-on Reset (POR) and, if enabled, after Power-up Timer (PWRT) has expired, or
- Wake-up from Sleep.

If the external clock oscillator is configured to be anything other than LP, XT or HS mode, then Two-Speed Start-up is disabled. This is because the external clock oscillator does not require any stabilization time after POR or an exit from Sleep.

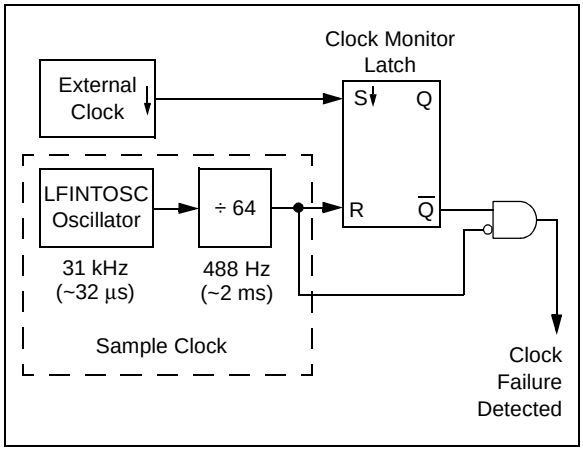
3.7.2 TWO-SPEED START-UP SEQUENCE

1. Wake-up from Power-on Reset or Sleep.
2. Instructions begin execution by the internal oscillator at the frequency set in the IRCF<2:0> bits of the OSCCON register.
3. OST enabled to count 1024 clock cycles.
4. OST timed out, wait for falling edge of the internal oscillator.
5. OSTS is set.
6. System clock held low until the next falling edge of new clock (LP, XT or HS mode).
7. System clock is switched to external clock source.

3.8 Fail-Safe Clock Monitor

The Fail-Safe Clock Monitor (FSCM) allows the device to continue operating should the external oscillator fail. The FSCM can detect oscillator failure any time after the Oscillator Start-up Timer (OST) has expired. The FSCM is enabled by setting the FCMEN bit in the Configuration Word register (CONFIG). The FSCM is applicable to all external oscillator modes (LP, XT, HS, EC, RC and RCIO).

FIGURE 3-8: FSCM BLOCK DIAGRAM



3.8.1 FAIL-SAFE DETECTION

The FSCM module detects a failed oscillator by comparing the external oscillator to the FSCM sample clock. The sample clock is generated by dividing the LFINTOSC by 64. See Figure 3-8. Inside the fail detector block is a latch. The external clock sets the latch on each falling edge of the external clock. The sample clock clears the latch on each rising edge of the sample clock. A failure is detected when an entire half-cycle of the sample clock elapses before the primary clock goes low.

3.8.2 FAIL-SAFE OPERATION

When the external clock fails, the FSCM switches the device clock to an internal clock source and sets the bit flag OSFIF of the PIR1 register. Setting this flag will generate an interrupt if the OSFIE bit of the PIE1 register is also set. The device firmware can then take steps to mitigate the problems that may arise from a failed clock. The system clock will continue to be sourced from the internal clock source until the device firmware successfully restarts the external oscillator and switches back to external operation.

The internal clock source chosen by the FSCM is determined by the IRCF<2:0> bits of the OSCCON register. This allows the internal oscillator to be configured before a failure occurs.

3.8.3 FAIL-SAFE CONDITION CLEARING

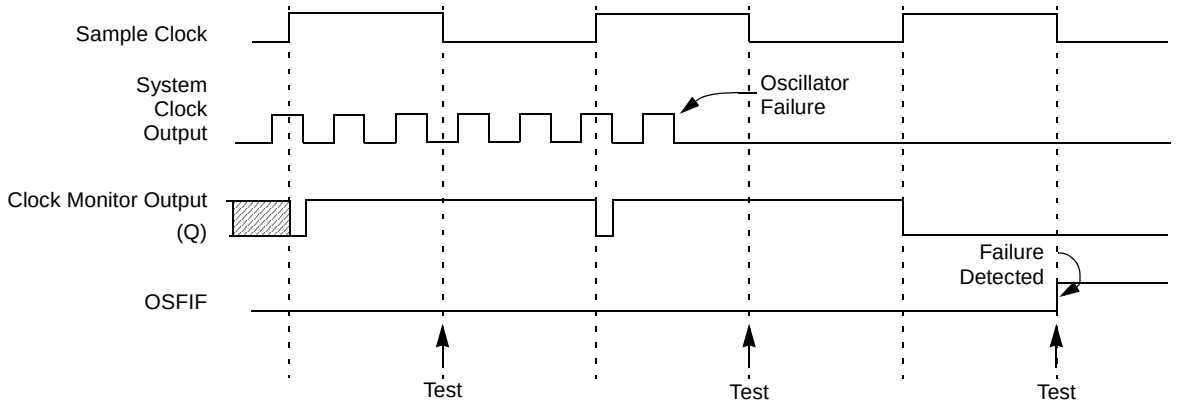
The Fail-Safe condition is cleared after a Reset, executing a `SLEEP` instruction or toggling the SCS bit of the OSCCON register. When the SCS bit is toggled, the OST is restarted. While the OST is running, the device continues to operate from the INTOSC selected in OSCCON. When the OST times out, the Fail-Safe condition is cleared and the device will be operating from the external clock source. The Fail-Safe condition must be cleared before the OSFIF flag can be cleared.

3.8.4 RESET OR WAKE-UP FROM SLEEP

The FSCM is designed to detect an oscillator failure after the Oscillator Start-up Timer (OST) has expired. The OST is used after waking up from Sleep and after any type of Reset. The OST is not used with the EC or RC Clock modes so that the FSCM will be active as soon as the Reset or wake-up has completed. When the FSCM is enabled, the Two-Speed Start-up is also enabled. Therefore, the device will always be executing code while the OST is operating.

Note:	Due to the wide range of oscillator start-up times, the Fail-Safe circuit is not active during oscillator start-up (i.e., after exiting Reset or Sleep). After an appropriate amount of time, the user should check the OSTS bit of the OSCCON register to verify the oscillator start-up and that the system clock switchover has successfully completed.

FIGURE 3-9: FSCM TIMING DIAGRAM



Note: The system clock is normally at a much higher frequency than the sample clock. The relative frequencies in this example have been chosen for clarity.

TABLE 3-2: SUMMARY OF REGISTERS ASSOCIATED WITH CLOCK SOURCES

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other Resets(1)
CONFIG(2)	$\overline{\text{CPD}}$	$\overline{\text{CP}}$	MCLRE	$\overline{\text{PWRTE}}$	WDTE	FOSC2	FOSC1	FOSC0	—	—
INTCON	GIE	PEIE	T0IE	INTE	RAIE	T0IF	INTF	RAIF	0000 000x	0000 000x
OSCCON	—	IRCF2	IRCF1	IRCF0	OSTS	HTS	LTS	SCS	-110 x000	-110 x000
OSCTUNE	—	—	—	TUN4	TUN3	TUN2	TUN1	TUN0	---0 0000	---u uuuu
PIE1	EEIE	LVDIE	CRIE	C2IE(3)	C1IE	OSFIE	—	TMR1IE	000- 00-0	000- 00-0
PIR1	EEIF	LVDIF	CRIF	C2IF(3)	C1IF	OSFIF	—	TMR1IF	000- 00-0	000- 00-0

Legend: x = unknown, u = unchanged, – = unimplemented locations read as '0'. Shaded cells are not used by oscillators.

Note 1: Other (non Power-up) Resets include $\overline{\text{MCLR}}$ Reset and Watchdog Timer Reset during normal operation.

2: See Configuration Word register (CONFIG) for operation of all register bits.

3: PIC16F636/639 only.

7.4 Comparator Control

The CMCON0 register (Register 7-1) provides access to the following comparator features:

- Mode selection
- Output state
- Output polarity
- Input switch

7.4.1 COMPARATOR OUTPUT STATE

Each comparator state can always be read internally via the CxOUT bit of the CMCON0 register. The comparator state may also be directed to the CxOUT pin in the following modes:

PIC12F635

- CM<2:0> = 001
- CM<2:0> = 011
- CM<2:0> = 101

PIC16F636/639

- CM<2:0> = 110

When one of the above modes is selected, the associated TRIS bit of the CxOUT pin must be cleared.

7.4.2 COMPARATOR OUTPUT POLARITY

Inverting the output of a comparator is functionally equivalent to swapping the comparator inputs. The polarity of a comparator output can be inverted by setting the CXINV bit of the CMCON0 register. Clearing CXINV results in a non-inverted output. A complete table showing the output state versus input conditions and the polarity bit is shown in Table 7-1.

TABLE 7-1: OUTPUT STATE VS. INPUT CONDITIONS

Input Conditions	CxINV	CxOUT
VIN- > VIN+	0	0
VIN- < VIN+	0	1
VIN- > VIN+	1	1
VIN- < VIN+	1	0

Note: CxOUT refers to both the register bit and output pin.

7.4.3 COMPARATOR INPUT SWITCH

The inverting input of the comparators may be switched between two analog pins in the following modes:

PIC12F635

- CM<2:0> = 101
- CM<2:0> = 110

PIC16F636/639

- CM<2:0> = 001 (Comparator C1 only)
- CM<2:0> = 010 (Comparators C1 and C2)

In the above modes, both pins remain in Analog mode regardless of which pin is selected as the input. The CIS bit of the CMCON0 register controls the comparator input switch.

REGISTER 7-2: CMCON0: COMPARATOR CONFIGURATION REGISTER (PIC16F636/639)

R-0	R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
C2OUT	C1OUT	C2INV	C1INV	CIS	CM2	CM1	CM0
bit 7							bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 7 **C2OUT:** Comparator 2 Output bit

When C2INV = 0:
1 = C2 V_{IN}+ > C2 V_{IN}-
0 = C2 V_{IN}+ < C2 V_{IN}-

When C2INV = 1:
1 = C2 V_{IN}+ < C2 V_{IN}-
0 = C2 V_{IN}+ > C2 V_{IN}-

bit 6 **C1OUT:** Comparator 1 Output bit

When C1INV = 0:
1 = C1 V_{IN}+ > C1 V_{IN}-
0 = C1 V_{IN}+ < C1 V_{IN}-

When C1INV = 1:
1 = C1 V_{IN}+ < C1 V_{IN}-
0 = C1 V_{IN}+ > C1 V_{IN}-

bit 5 **C2INV:** Comparator 2 Output Inversion bit

1 = C2 output inverted
0 = C2 output not inverted

bit 4 **C1INV:** Comparator 1 Output Inversion bit

1 = C1 Output inverted
0 = C1 Output not inverted

bit 3 **CIS:** Comparator Input Switch bit

When CM<2:0> = 010:

1 = C1IN+ connects to C1 V_{IN}-
C2IN+ connects to C2 V_{IN}-
0 = C1IN- connects to C1 V_{IN}-
C2IN- connects to C2 V_{IN}-

When CM<2:0> = 001:
1 = C1IN+ connects to C1 V_{IN}-
0 = C1IN- connects to C1 V_{IN}-

bit 2-0 **CM<2:0>:** Comparator Mode bits (See Figure 7-5)

000 = Comparators off. CxIN pins are configured as analog
001 = Three inputs multiplexed to two comparators
010 = Four inputs multiplexed to two comparators
011 = Two common reference comparators
100 = Two independent comparators
101 = One independent comparator
110 = Two comparators with outputs and common reference
111 = Comparators off. CxIN pins are configured as digital I/O

NOTES:

11.20 Soft Reset

The AFE issues a Soft Reset in the following events:

a) After Power-on Reset (POR),
b) After Inactivity timer time-out,
c) If an “Abort” occurs,
d) After receiving SPI Soft Reset command.

The “Abort” occurs if there is no positive signal detected at the end of the AGC stabilization period (TAGC). The Soft Reset initializes internal circuits and brings the AFE into a low current Standby mode operation. The internal circuits that are initialized by the Soft Reset include:

- Output Enable Filter
- AGC circuits
- Demodulator
- 32 kHz Internal Oscillator

The Soft Reset has no effect on the Configuration register setup, except for some of the AFE Status Register 7 bits. (Register 11-8).

The circuit initialization takes one internal clock cycle (1/32 kHz = 31.25 μs). During the initialization, the modulation transistors between each input and LCCOM pins are turned-on to discharge any internal/external parasitic charges. The modulation transistors are turned-off immediately after the initialization time.

The Soft Reset is executed in Active mode only. It is not valid in Standby mode.

11.21 Minimum Modulation Depth Requirement for Input Signal

The AFE demodulates the modulated input signal if the modulation depth of the input signal is greater than the minimum requirement that is programmed in the AFE Configuration Register 5 (Register 11-6). Figure 11-7 shows the definition of the modulation depth and examples. MODMIN<6:5> of the Configuration Register 5 offer four options. They are 75%, 50%, 25% and 12%, with a default setting of 50%.

The purpose of this feature is to enhance the demodulation integrity of the input signal. The 12% setting is the best choice for the input signal with weak modulation depth, which is typically observed near the high-voltage base station antenna and also at far-distance from the base station antenna. It gives the best demodulation sensitivity, but is very susceptible to noise spikes that can result in a bit detection error. The 75% setting can reduce the bit errors caused by noise, but gives the least demodulation sensitivity. See Table 11-3 for minimum modulation depth requirement settings.

TABLE 11-3: SETTING FOR MINIMUM MODULATION DEPTH REQUIREMENT

MODMIN Bits (Config. Register 5)		Modulation Depth
Bit 6	Bit 5	
0	0	50% (default)
0	1	75%
1	0	25%
1	1	12%

REGISTER 11-2: CONFIGURATION REGISTER 1

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
DATOUT1	DATOUT0	LCXTUN5	LCXTUN4	LCXTUN3	LCXTUN2	LCXTUN1	LCXTUN0	R1PAR
bit 8								bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 8-7 **DATOUT<1:0>:** LFDATA Output type bit
00 = Demodulated output
01 = Carrier Clock output
10 = RSSI output
11 = RSSI output

bit 6-1 **LCXTUN<5:0>:** LCX Tuning Capacitance bit
000000 = +0 pF (Default)
:
111111 = +63 pF

bit 0 **R1PAR**: Register Parity Bit – set/cleared so the 9-bit register contains odd parity – an odd number of set bits

REGISTER 11-3: CONFIGURATION REGISTER 2

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
RSSIFET	CLKDIV	LCYTUN5	LCYTUN4	LCYTUN3	LCYTUN2	LCYTUN1	LCYTUN0	R2PAR
bit 8								bit 0

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

bit 8 **RSSIFET**: Pull-down MOSFET on LFDATA pad bit (controllable by user in the RSSI mode only)
1 = Pull-down RSSI MOSFET on
0 = Pull-down RSSI MOSFET off

bit 7 **CLKDIV:** Carrier Clock Divide-by bit
1 = Carrier Clock/4
0 = Carrier Clock/1

bit 6-1 **LCYTUN<5:0>:** LCY Tuning Capacitance bit
000000 = +0 pF (Default)
:
111111 = +63 pF

bit 0 **R2PAR**: Register Parity Bit – set/cleared so the 9-bit register contains odd parity – an odd number of set bits

DECFSZ **Decrement f, Skip if 0**

Syntax:	[*label*] DECFSZ f,d
Operands:	0 ≤ f ≤ 127 d ∈ [0,1]
Operation:	(f) - 1 → (destination); skip if result = 0
Status Affected:	None
Description:	The contents of register 'f' are decremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'. If the result is '1', the next instruction is executed. If the result is '0', then a NOP is executed instead, making it a two-cycle instruction.

GOTO **Unconditional Branch**

Syntax:	[*label*] GOTO k
Operands:	0 ≤ k ≤ 2047
Operation:	k → PC<10:0> PCLATH<4:3> → PC<12:11>
Status Affected:	None
Description:	GOTO is an unconditional branch. The eleven-bit immediate value is loaded into PC bits <10:0>. The upper bits of PC are loaded from PCLATH<4:3>. GOTO is a two-cycle instruction.

INCF **Increment f**

Syntax:	[*label*] INCF f,d
Operands:	0 ≤ f ≤ 127 d ∈ [0,1]
Operation:	(f) + 1 → (destination)
Status Affected:	Z
Description:	The contents of register 'f' are incremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.

INCFSZ **Increment f, Skip if 0**

Syntax:	[*label*] INCFSZ f,d
Operands:	0 ≤ f ≤ 127 d ∈ [0,1]
Operation:	(f) + 1 → (destination), skip if result = 0
Status Affected:	None
Description:	The contents of register 'f' are incremented. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'. If the result is '1', the next instruction is executed. If the result is '0', a NOP is executed instead, making it a two-cycle instruction.

IORLW **Inclusive OR literal with W**

Syntax:	[*label*] IORLW k
Operands:	0 ≤ k ≤ 255
Operation:	(W) .OR. k → (W)
Status Affected:	Z
Description:	The contents of the W register are OR'ed with the eight-bit literal 'k'. The result is placed in the W register.

IORWF **Inclusive OR W with f**

Syntax:	[*label*] IORWF f,d
Operands:	0 ≤ f ≤ 127 d ∈ [0,1]
Operation:	(W) .OR. (f) → (destination)
Status Affected:	Z
Description:	Inclusive OR the W register with register 'f'. If 'd' is '0', the result is placed in the W register. If 'd' is '1', the result is placed back in register 'f'.

RETFIE **Return from Interrupt**

Syntax: [*label*] RETFIE

Operands: None

Operation: TOS → PC,
1 → GIE

Status Affected: None

Description: Return from Interrupt. Stack is POPed and Top-of-Stack (TOS) is loaded in the PC. Interrupts are enabled by setting Global Interrupt Enable bit, GIE (INTCON<7>). This is a two-cycle instruction.

Words: 1

Cycles: 2

Example:

```
RETFIE
```

After Interrupt
PC = TOS
GIE = 1

RETLW **Return with literal in W**

Syntax: [*label*] RETLW k

Operands: 0 ≤ k ≤ 255

Operation: k → (W);
TOS → PC

Status Affected: None

Description: The W register is loaded with the eight-bit literal 'k'. The program counter is loaded from the top of the stack (the return address). This is a two-cycle instruction.

Words: 1

Cycles: 2

Example:

```
CALL TABLE;W contains table
    ;offset value
TABLE
•   ;W now has table value
•
•
ADDWF PC  ;W = offset
RETLW k1  ;Begin table
RETLW k2  ;
•
•
•
RETLW kn  ; End of table
```

Before Instruction
W = 0x07
After Instruction
W = value of k8

RETURN **Return from Subroutine**

Syntax: [*label*] RETURN

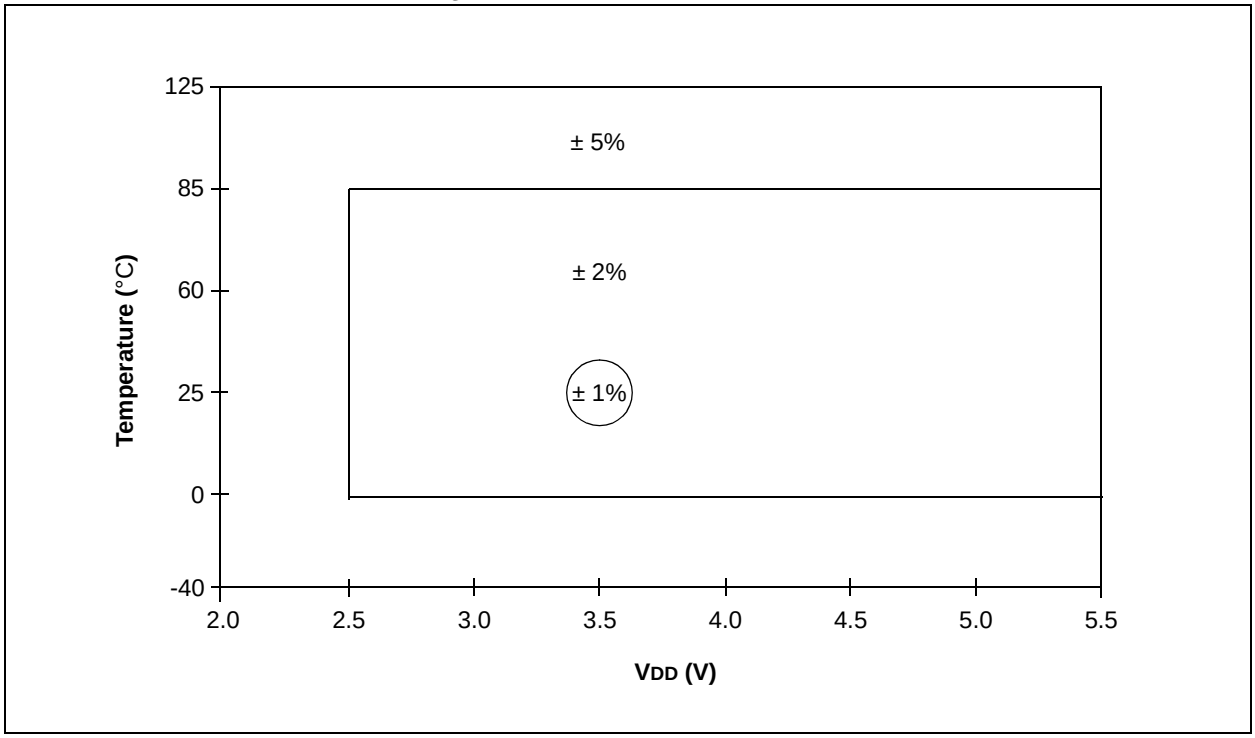
Operands: None

Operation: TOS → PC

Status Affected: None

Description: Return from subroutine. The stack is POPed and the top of the stack (TOS) is loaded into the program counter. This is a two-cycle instruction.

FIGURE 15-3: HFINTOSC FREQUENCY ACCURACY OVER DEVICE VDD AND TEMPERATURE



15.1 DC Characteristics: PIC12F635/PIC16F636-I (Industrial) PIC12F635/PIC16F636-E (Extended)

DC CHARACTERISTICS			Standard Operating Conditions (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for industrial -40°C ≤ TA ≤ +125°C for extended				
Param No.	**Sym**	**Characteristic**	**Min**	**Typ†**	**Max**	**Units**	**Conditions**
	VDD	**Supply Voltage**					
D001			2.0	—	5.5	V	FOSC < = 4 MHz
D001A			2.0	—	5.5	V	FOSC < = 8 MHz, HFINTOSC, EC
D001B			3.0	—	5.5	V	FOSC < = 10 MHz
D001C			4.5	—	5.5	V	FOSC < = 20 MHz
D002	VDR	**RAM Data Retention Voltage(1)**	1.5*	—	—	V	Device in Sleep mode
D003	VPOR	**VDD Start Voltage** to ensure internal Power-on Reset signal	—	VSS	—	V	See **Section 12.3 "Power-on Reset"** for details.
D004	SVDD	**VDD Rise Rate** to ensure internal Power-on Reset signal	0.05*	—	—	V/ms	See **Section 12.3 "Power-on Reset"** for details.
D005	VBOD	**Brown-out Reset**	2.0	2.1	2.2	V	

* These parameters are characterized but not tested.

† Data in "Typ" column is at 5.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

Note 1: This is the limit to which VDD can be lowered in Sleep mode without losing RAM data.

16.0 DC AND AC CHARACTERISTICS GRAPHS AND TABLES

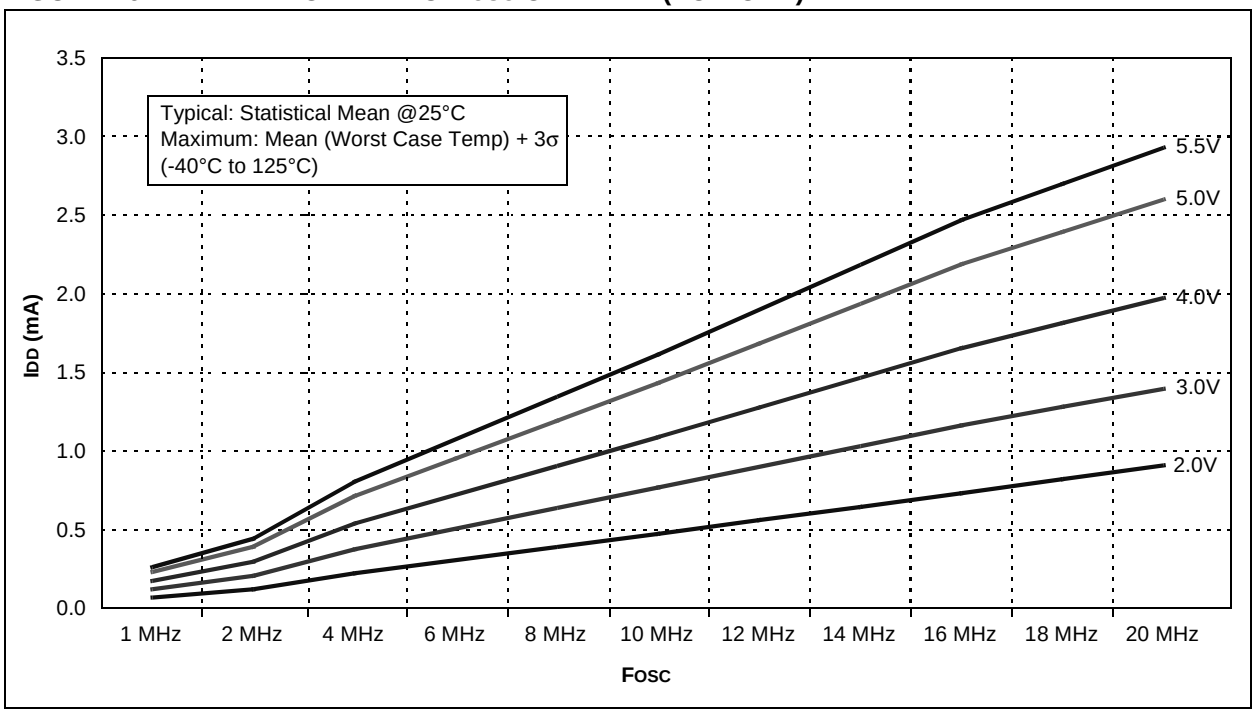
The graphs and tables provided in this section are for **design guidance** and are **not tested**.

In some graphs or tables, the data presented are **outside specified operating range** (i.e., outside specified V_{DD} range). This is for **information only** and devices are ensured to operate properly only within the specified range.

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore, outside the warranted range.

"Typical" represents the mean of the distribution at 25°C. "Maximum" or "minimum" represents (mean + 3σ) or (mean - 3σ) respectively, where σ is a standard deviation, over each temperature range.

FIGURE 16-1: TYPICAL I_{DD} vs. F_{OSC} OVER V_{DD} (EC MODE)



NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	X	/XX	XXX
Device	Temperature Range	Package	Pattern

Device:	PIC12F635(1, 2), PIC16F636(1, 2), PIC16F639(1, 2) VDD range 2.0V to 5.5V	
Temperature Range:	I = -40°C to +85°C (Industrial) E = -40°C to +125°C (Extended)	
Package:	MD = Dual-Flat, No Leads, 8-pin (4x4x0.9 mm) MF = Dual-Flat, No Leads, Saw Sing. (6x5 mm) ML = Dual-Flat, No Leads, 16-pin (4x4x0.9 mm) P = Plastic DIP (300 mil body, 5.30 mm) SL = 14-lead Small Outline (3.90 mm) SN = 8-lead Small Outline (3.90 mm) SS = 20-Lead Plastic Shrink Small Outline (5.30 mm) ST = 14-Lead Thin Shrink Small Outline (4.4 mm)	
Pattern:	3-Digit Pattern Code for QTP (blank otherwise)	

Examples:

a) PIC12F635-E/P 301 = Extended Temp., PDIP package, 20 MHz, QTP pattern #301

b) PIC12F635-I/S = Industrial Temp., SOIC package, 20 MHz

Note 1: F = Standard Voltage Range

2: T = in tape and reel PLCC.