MIXED SIGNAL MICROCONTROLLER

FEATURES

- **Low Supply Voltage Range: 1.8 V to 3.6 V**
- **Ultralow Power Consumption**
  - **Active Mode (AM): TBD**
  - **Standby Mode (LPM3 WDT Mode): TBD**
  - **Off Mode (LPM4 RAM Retention): TBD**
  - **Shutdown Mode (LPM3.5 RTC Mode): TBD**
  - **Shutdown Mode (LPM4.5): TBD**
- **Wake-Up From Standby Mode in Less Than 5 µs**
- **16-Bit RISC Architecture, Extended Memory, up to 20-MHz System Clock**
- **Flexible Power Management System**
  - **Fully Integrated LDO With Programmable Regulated Core Supply Voltage**
  - **Supply Voltage Supervision, Monitoring, and Brownout**
- **Unified Clock System**
  - **FLL Control Loop for Frequency Stabilization**
  - **Low-Power/Low-Frequency Internal Clock Source (VLO)**
  - **Low-Frequency Trimmed Internal Reference Source (REFO)**
  - **32-kHz Crystals (XT1)**
  - **High-Frequency Crystals Up to 32 MHz (XT2)**
- **16-Bit Timer TA0, Timer_A With Five Capture/Compare Registers**
- **16-Bit Timer TA1, Timer_A With Three Capture/Compare Registers**
- **16-Bit Timer TA2, Timer_A With Three Capture/Compare Registers**
- **16-Bit Timer TB0, Timer_B With Seven Capture/Compare Shadow Registers**

- **Two Universal Serial Communication Interfaces**
  - **USCI_A0 and USCI_A1 Each Supporting**
    - **Enhanced UART Supporting Auto-Baudrate Detection**
    - **IrDA Encoder and Decoder**
    - **Synchronous SPI**
  - **USCI_B0 and USCI_B1 Each Supporting**
    - **I²C™**
    - **Synchronous SPI**
- **Integrated 3.3-V Power System**
- **12-Bit Analog-to-Digital (A/D) Converter With Internal Shared Reference, Sample-and-Hold, and Autoscan Feature**
- **Dual 12-Bit Digital-to-Analog (D/A) Converters With Synchronization (Available on 'F6438, 'F6437, and 'F6436 Devices)**
- **Comparator**
- **Integrated LCD Driver With Contrast Control for up to 160 Segments**
- **Hardware Multiplier Supporting 32-Bit Operations**
- **Flash Memory**
  - **Serial Onboard Programming, No External Programming Voltage Needed**
- **Six-Channel Internal DMA**
- **Real-Time Clock Module With Supply Voltage Backup Switch**
- **Family Members are Summarized in Table 1**
- **For Complete Module Descriptions, See the *MSP430x5xx/MSP430x6xx Family User's Guide* (SLAU208)**

PRODUCT PREVIEW

DESCRIPTION

The Texas Instruments MSP430 family of ultralow-power microcontrollers consists of several devices featuring different sets of peripherals targeted for various applications. The architecture, combined with five low power modes is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 5 µs.

![warning symbol] Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

The MSP430F643x series are microcontroller configurations with four 16-bit timers, a high performance 12-bit analog-to-digital (A/D) converter, two universal serial communication interfaces (USCI), hardware multiplier, DMA, real-time clock module with alarm capabilities, comparator, and up to 74 I/O pins.

Typical applications for this device include analog and digital sensor systems, digital motor control, remote controls, thermostats, digital timers, hand-held meters, etc.

Family members available are summarized in Table 1.

Table 1. Family Members

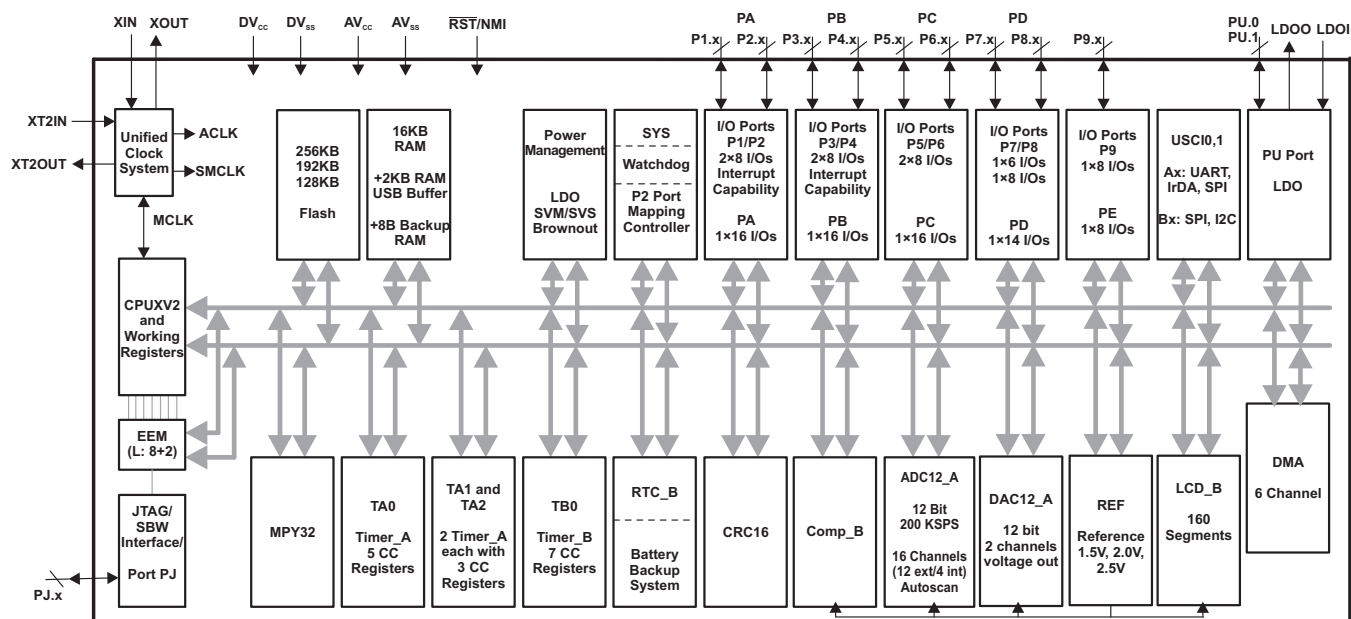| Device	Flash (KB)	SRAM (KB)	Timer_A[1]	Timer_B[2]	USCI Channel A: UART/IrDA/ SPI	USCI Channel B: SPI/I²C	ADC12_A (Ch)	DAC12_A (Ch)	Comp_B (Ch)	I/O	Package Type
MSP430F6438	256	18	5, 3, 3	7	2	2	12 ext / 4 int	2	12	74	100 PZ, 113 ZQW
MSP430F6437[3]	192	18	5, 3, 3	7	2	2	12 ext / 4 int	2	12	74	100 PZ, 113 ZQW
MSP430F6436[4]	128	18	5, 3, 3	7	2	2	12 ext / 4 int	2	12	74	100 PZ, 113 ZQW
MSP430F6435[4]	256	18	5, 3, 3	7	2	2	12 ext / 4 int	-	12	74	100 PZ, 113 ZQW
MSP430F6434[4]	192	18	5, 3, 3	7	2	2	12 ext / 4 int	-	12	74	100 PZ, 113 ZQW
MSP430F6433[4]	128	10	5, 3, 3	7	2	2	12 ext / 4 int	-	12	74	100 PZ, 113 ZQW

(1)   Each number in the sequence represents an instantiation of Timer_A with its associated number of capture compare registers and PWM output generators available. For example, a number sequence of 3, 5 would represent two instantiations of Timer_A, the first instantiation having 3 and the second instantiation having 5 capture compare registers and PWM output generators, respectively.
(2)   Each number in the sequence represents an instantiation of Timer_B with its associated number of capture compare registers and PWM output generators available. For example, a number sequence of 3, 5 would represent two instantiations of Timer_B, the first instantiation having 3 and the second instantiation having 5 capture compare registers and PWM output generators, respectively.
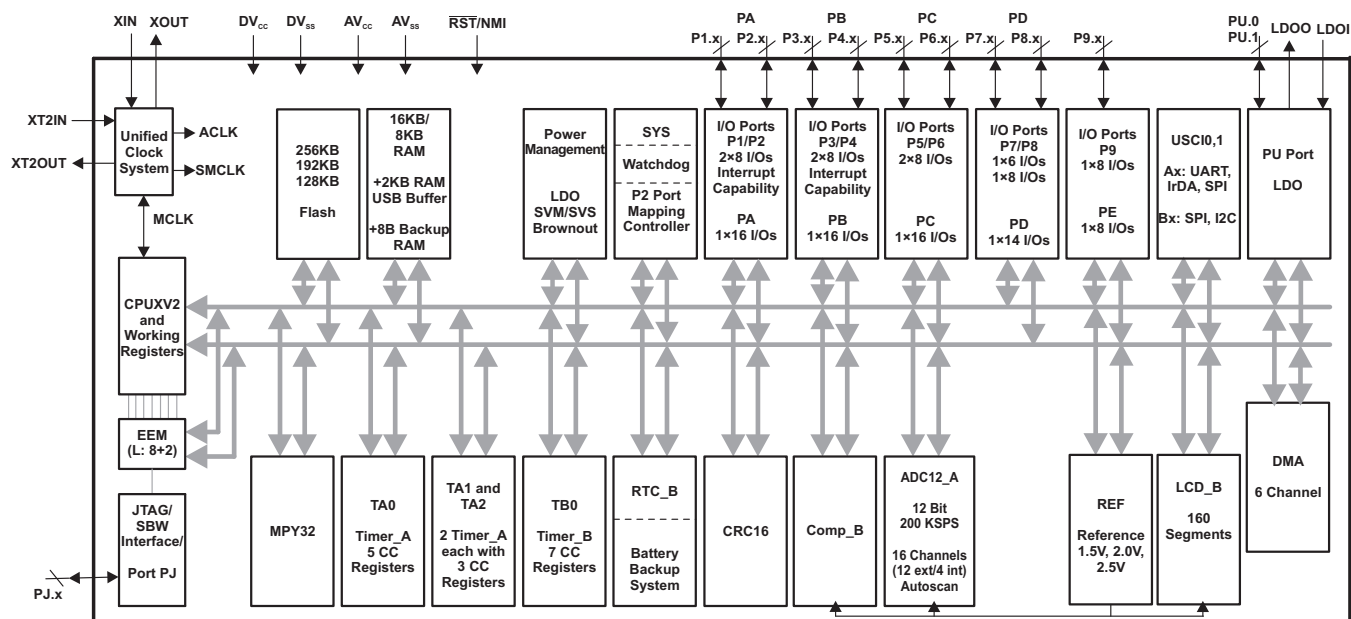(3)   Product Preview
(4)   Product Preview

Ordering Information[1]

T_A	PACKAGED DEVICES[2]	
	PLASTIC 100-PIN TQFP (PZ)	PLASTIC 113-BALL BGA (ZQW)
–40°C to 85°C	MSP430F6438IPZ[3]	MSP430F6438IZQW[3]
	MSP430F6437IPZ[3]	MSP430F6437IZQW[3]
	MSP430F6436IPZ[3]	MSP430F6436IZQW[3]
	MSP430F6435IPZ[3]	MSP430F6435IZQW[3]
	MSP430F6434IPZ[3]	MSP430F6434IZQW[3]
	MSP430F6433IPZ[3]	MSP430F6433IZQW[3]

(1)   For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2)   Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/package.
(3)   Product preview.

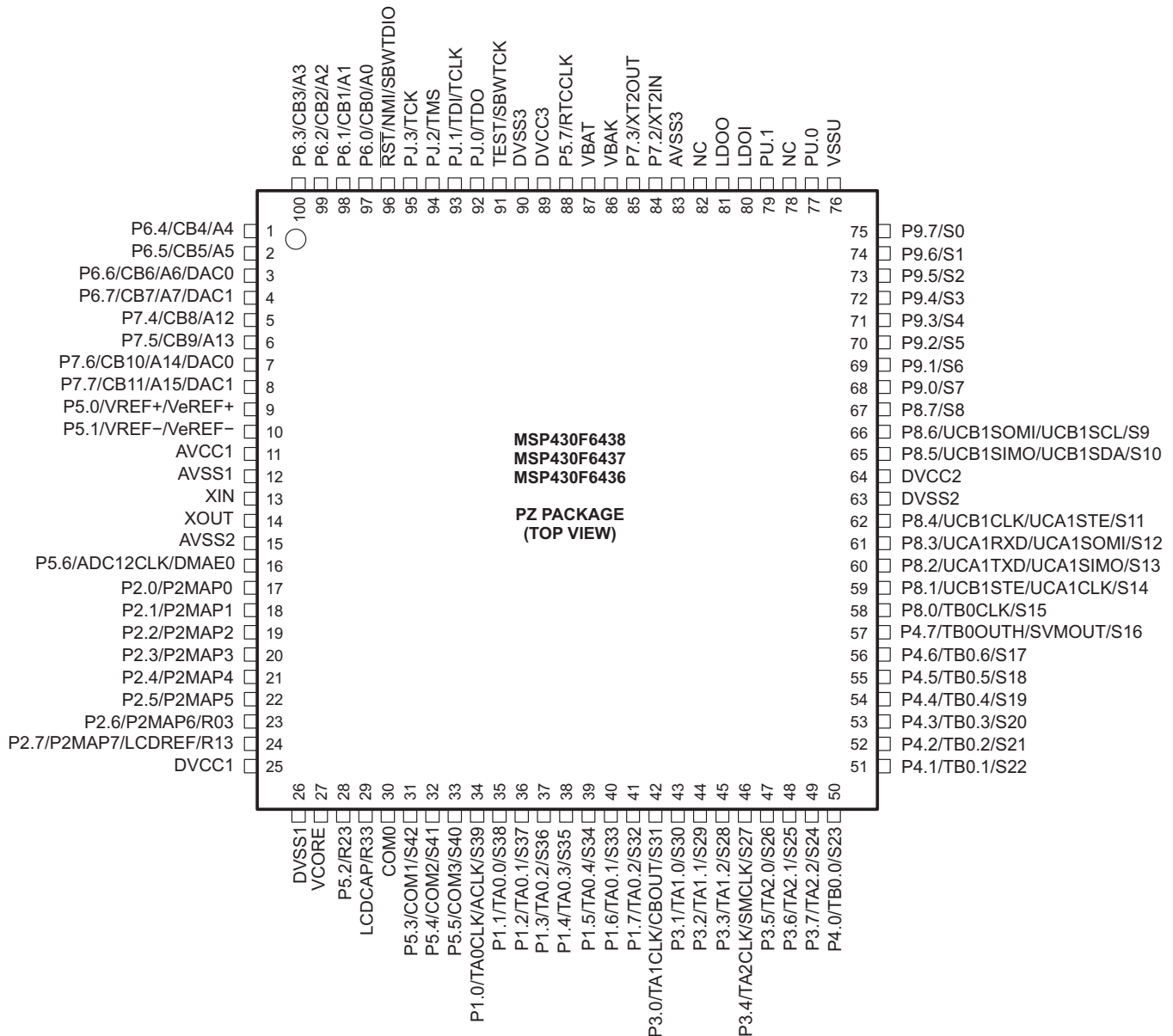## Functional Block Diagram, MSP430F6438, MSP430F6437, MSP430F6436

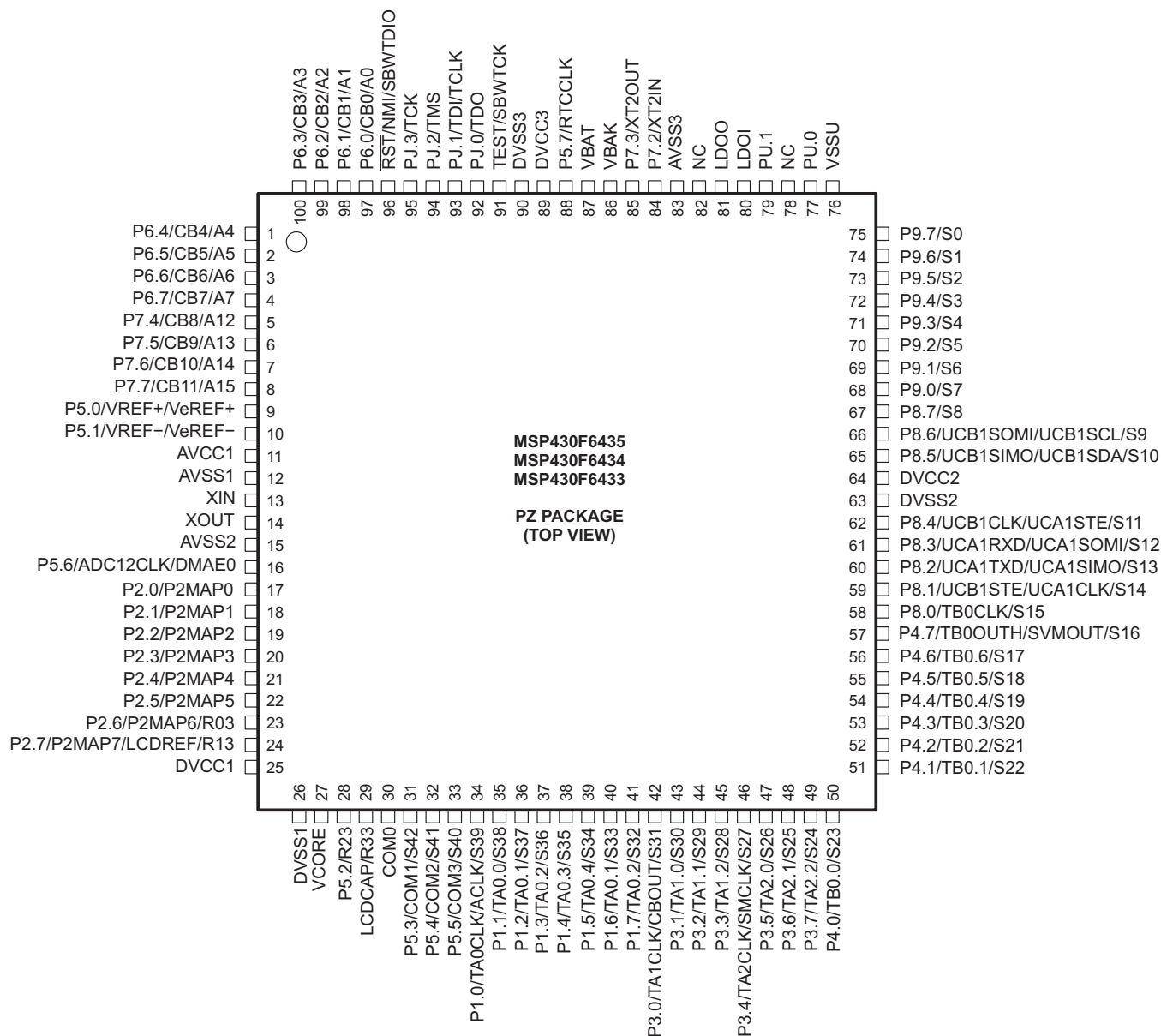## Functional Block Diagram, MSP430F6435, MSP430F6434, MSP430F6433

PRODUCT PREVIEW

Pin Designation, MSP430F6438IPZ, MSP430F6437IPZ, MSP430F6436IPZ

PRODUCT PREVIEW

Left side pins (1-25):

- 1 P6.4/CB4/A4
- 2 P6.5/CB5/A5
- 3 P6.6/CB6/A6/DAC0
- 4 P6.7/CB7/A7/DAC1
- 5 P7.4/CB8/A12
- 6 P7.5/CB9/A13
- 7 P7.6/CB10/A14/DAC0
- 8 P7.7/CB11/A15/DAC1
- 9 P5.0/VREF+/VeREF+
- 10 P5.1/VREF−/VeREF−
- 11 AVCC1
- 12 AVSS1
- 13 XIN
- 14 XOUT
- 15 AVSS2
- 16 P5.6/ADC12CLK/DMAE0
- 17 P2.0/P2MAP0
- 18 P2.1/P2MAP1
- 19 P2.2/P2MAP2
- 20 P2.3/P2MAP3
- 21 P2.4/P2MAP4
- 22 P2.5/P2MAP5
- 23 P2.6/P2MAP6/R03
- 24 P2.7/P2MAP7/LCDREF/R13
- 25 DVCC1

Top side pins (100-76):

- 100 P6.3/CB3/A3
- 99 P6.2/CB2/A2
- 98 P6.1/CB1/A1
- 97 P6.0/CB0/A0
- 96 RST/NMI/SBWTDIO
- 95 PJ.3/TCK
- 94 PJ.2/TMS
- 93 PJ.1/TDI/TCLK
- 92 PJ.0/TDO
- 91 TEST/SBWTCK
- 90 DVSS3
- 89 DVCC3
- 88 P5.7/RTCCLK
- 87 VBAT
- 86 VBAK
- 85 P7.3/XT2OUT
- 84 P7.2/XT2IN
- 83 AVSS3
- 82 NC
- 81 LDOO
- 80 LDOI
- 79 PU.1
- 78 NC
- 77 PU.0
- 76 VSSU

Center:

MSP430F6438
MSP430F6437
MSP430F6436

PZ PACKAGE
(TOP VIEW)

Right side pins (75-51):

- 75 P9.7/S0
- 74 P9.6/S1
- 73 P9.5/S2
- 72 P9.4/S3
- 71 P9.3/S4
- 70 P9.2/S5
- 69 P9.1/S6
- 68 P9.0/S7
- 67 P8.7/S8
- 66 P8.6/UCB1SOMI/UCB1SCL/S9
- 65 P8.5/UCB1SIMO/UCB1SDA/S10
- 64 DVCC2
- 63 DVSS2
- 62 P8.4/UCB1CLK/UCA1STE/S11
- 61 P8.3/UCA1RXD/UCA1SOMI/S12
- 60 P8.2/UCA1TXD/UCA1SIMO/S13
- 59 P8.1/UCB1STE/UCA1CLK/S14
- 58 P8.0/TB0CLK/S15
- 57 P4.7/TB0OUTH/SVMOUT/S16
- 56 P4.6/TB0.6/S17
- 55 P4.5/TB0.5/S18
- 54 P4.4/TB0.4/S19
- 53 P4.3/TB0.3/S20
- 52 P4.2/TB0.2/S21
- 51 P4.1/TB0.1/S22

Bottom side pins (26-50):

- 26 DVSS1
- 27 VCORE
- 28 P5.2/R23
- 29 LCDCAP/R33
- 30 COM0
- 31 P5.3/COM1/S42
- 32 P5.4/COM2/S41
- 33 P5.5/COM3/S40
- 34 P1.0/TA0CLK/ACLK/S39
- 35 P1.1/TA0.0/S38
- 36 P1.2/TA0.1/S37
- 37 P1.3/TA0.2/S36
- 38 P1.4/TA0.3/S35
- 39 P1.5/TA0.4/S34
- 40 P1.6/TA0.1/S33
- 41 P1.7/TA0.2/S32
- 42 P3.0/TA1CLK/CBOUT/S31
- 43 P3.1/TA1.0/S30
- 44 P3.2/TA1.1/S29
- 45 P3.3/TA1.2/S28
- 46 P3.4/TA2CLK/SMCLK/S27
- 47 P3.5/TA2.0/S26
- 48 P3.6/TA2.1/S25
- 49 P3.7/TA2.2/S24
- 50 P4.0/TB0.0/S23

CAUTION: LCDCAP/R33 must be connected to DV$_{SS}$ if not used.

Pin Designation, MSP430F6435IPZ, MSP430F6434IPZ, MSP430F6433IPZ

Top pins (left to right): P6.3/CB3/A3, P6.2/CB2/A2, P6.1/CB1/A1, P6.0/CB0/A0, RST/NMI/SBWTDIO, PJ.3/TCK, PJ.2/TMS, PJ.1/TDI/TCLK, PJ.0/TDO, TEST/SBWTCK, DVSS3, DVCC3, P5.7/RTCCLK, VBAT, VBAK, P7.3/XT2OUT, P7.2/XT2IN, AVSS3, NC, LDOO, LDOI, PU.1, NC, PU.0, VSSU

Pin numbers top (left to right): 100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 85, 84, 83, 82, 81, 80, 79, 78, 77, 76

Left side pins:
- 1 — P6.4/CB4/A4
- 2 — P6.5/CB5/A5
- 3 — P6.6/CB6/A6
- 4 — P6.7/CB7/A7
- 5 — P7.4/CB8/A12
- 6 — P7.5/CB9/A13
- 7 — P7.6/CB10/A14
- 8 — P7.7/CB11/A15
- 9 — P5.0/VREF+/VeREF+
- 10 — P5.1/VREF−/VeREF−
- 11 — AVCC1
- 12 — AVSS1
- 13 — XIN
- 14 — XOUT
- 15 — AVSS2
- 16 — P5.6/ADC12CLK/DMAE0
- 17 — P2.0/P2MAP0
- 18 — P2.1/P2MAP1
- 19 — P2.2/P2MAP2
- 20 — P2.3/P2MAP3
- 21 — P2.4/P2MAP4
- 22 — P2.5/P2MAP5
- 23 — P2.6/P2MAP6/R03
- 24 — P2.7/P2MAP7/LCDREF/R13
- 25 — DVCC1

Center:
MSP430F6435
MSP430F6434
MSP430F6433

PZ PACKAGE
(TOP VIEW)

Right side pins:
- 75 — P9.7/S0
- 74 — P9.6/S1
- 73 — P9.5/S2
- 72 — P9.4/S3
- 71 — P9.3/S4
- 70 — P9.2/S5
- 69 — P9.1/S6
- 68 — P9.0/S7
- 67 — P8.7/S8
- 66 — P8.6/UCB1SOMI/UCB1SCL/S9
- 65 — P8.5/UCB1SIMO/UCB1SDA/S10
- 64 — DVCC2
- 63 — DVSS2
- 62 — P8.4/UCB1CLK/UCA1STE/S11
- 61 — P8.3/UCA1RXD/UCA1SOMI/S12
- 60 — P8.2/UCA1TXD/UCA1SIMO/S13
- 59 — P8.1/UCB1STE/UCA1CLK/S14
- 58 — P8.0/TB0CLK/S15
- 57 — P4.7/TB0OUTH/SVMOUT/S16
- 56 — P4.6/TB0.6/S17
- 55 — P4.5/TB0.5/S18
- 54 — P4.4/TB0.4/S19
- 53 — P4.3/TB0.3/S20
- 52 — P4.2/TB0.2/S21
- 51 — P4.1/TB0.1/S22

Pin numbers bottom (left to right): 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

Bottom pins (left to right): DVSS1, VCORE, P5.2/R23, LCDCAP/R33, COM0, P5.3/COM1/S42, P5.4/COM2/S41, P5.5/COM3/S40, P1.0/TA0CLK/ACLK/S39, P1.1/TA0.0/S38, P1.2/TA0.1/S37, P1.3/TA0.2/S36, P1.4/TA0.3/S35, P1.5/TA0.4/S34, P1.6/TA0.1/S33, P1.7/TA0.2/S32, P3.0/TA1CLK/CBOUT/S31, P3.1/TA1.0/S30, P3.2/TA1.1/S29, P3.3/TA1.2/S28, P3.4/TA2CLK/SMCLK/S27, P3.5/TA2.0/S26, P3.6/TA2.1/S25, P3.7/TA2.2/S24, P4.0/TB0.0/S23

CAUTION: LCDCAP/R33 must be connected to DV$_{SS}$ if not used.

PRODUCT PREVIEW

Pin Designation, MSP430F6438IZQW, MSP430F6437IZQW, MSP430F6436IZQW, MSP430F6432IZQW, MSP430F6431IZQW, MSP430F6430IZQW

ZQW PACKAGE
(TOP VIEW)

PRODUCT PREVIEW

REVISION HISTORY

REVISION	COMMENTS
SLAS720	Product Preview release

PRODUCT PREVIEW

IMPORTANT NOTICE