



rev 1.0

General Purpose EMI Reduction IC

Features

- Provides up to 15 dB of EMI suppression
- FCC approved method of EMI attenuation
- Generates a 1X, 2X, and 4X low EMI spread spectrum clock of the input frequency
- Input frequency range from 3 to 78 MHz
- External loop filter for spread % adjustment
- Spreading ranges from $\pm 0.25\%$ to $\pm 5.0\%$
- Ultra low cycle-to-cycle jitter
- Zero-cycle slip
- 3.3V operating voltage range
- 10 mA output drives
- TTL or CMOS compatible outputs
- Ultra-low power CMOS design
- Available in 8 pin SOIC and TSSOP
- Available for industrial and automotive temperature ranges.

Product Description

The P278xx is a versatile spread spectrum frequency modulator designed specifically for digital camera and other digital video and imaging applications. The P278xx reduces electromagnetic interference (EMI) at the clock source, which provides system wide reduction of EMI of all clock

dependent signals. The P278xx allows significant system cost savings by reducing the number of circuit board layers and shielding that are traditionally required to pass EMI regulations.

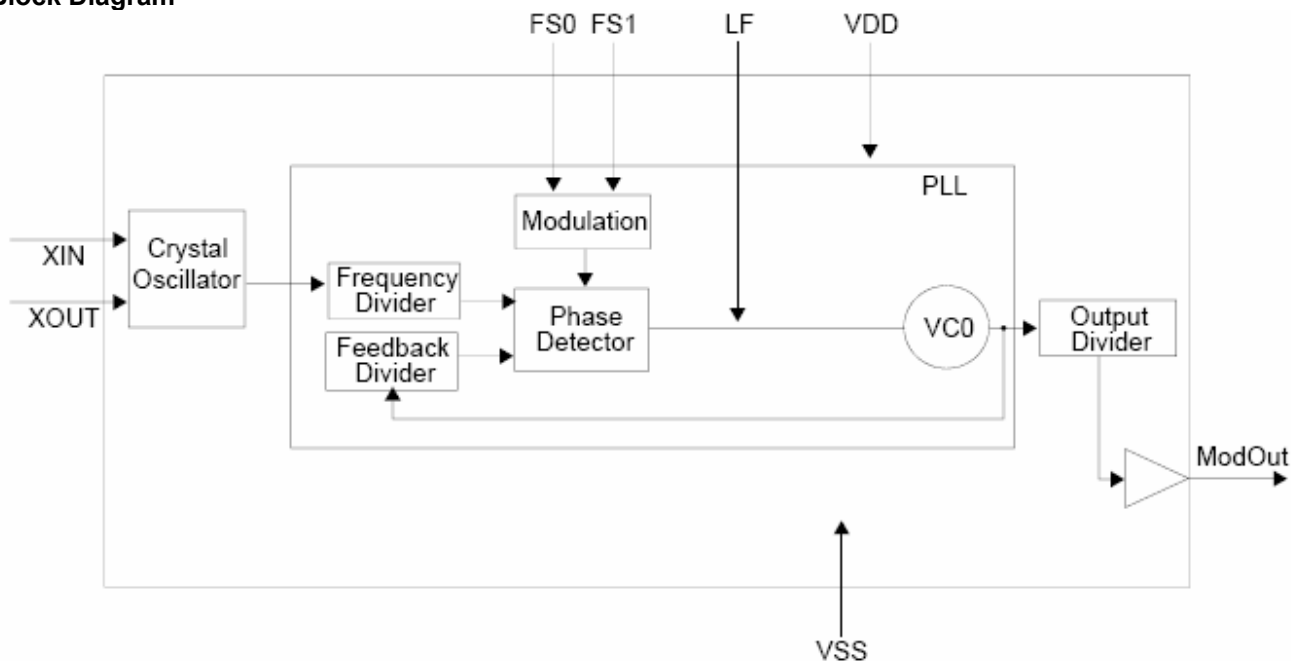
The P278xx uses the most efficient and optimized modulation profile approved by the FCC.

The P278xx modulates the output of a single PLL in order to "spread" the bandwidth of a synthesized clock and, more importantly, decreases the peak amplitudes of its harmonics. This results in significantly lower system EMI compared to the typical narrow band signal produced by oscillators and most frequency generators. Lowering EMI by increasing a signal's bandwidth is called spread spectrum clock generation.

Applications

The P278xx is targeted towards MFP, xDSL, fax modem, set-top box, USB controller, DSC, and embedded systems.

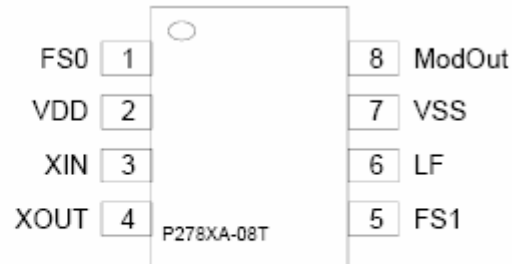
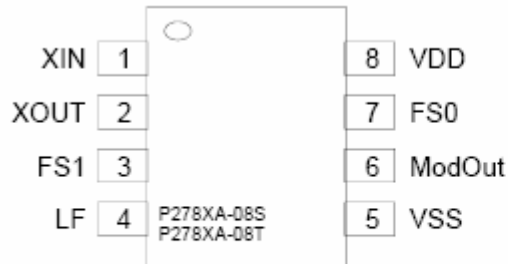
Block Diagram





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Pin Configuration



Pin Description (P278XA)

| Pin# | Pin Name | Type | Description |
|------|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | XIN/CLKIN | I | Connect to crystal or clock input. |
| 2 | XOUT | I | Crystal output |
| 3 | FS1 | I | Digital logic input used to select input frequency range (see the Input Frequency Selection Table). This pin has an internal pull-up resistor. |
| 4 | LF | I | External Loop Filter for the PLL. By changing the value of the CRC circuit, the percentage spread can be adjusted accordingly. See the Loop Filter Selection Table for detail value. |
| 5 | VSS | I | Ground Connection. Connect to system ground. |
| 6 | ModOUT | O | Spread Spectrum Clock Output. |
| 7 | FS0 | I | Digital logic input used to select input frequency range (see the Input Frequency Selection Table). This pin has an internal pull-up resistor. |
| 8 | VDD | P | Connect to +3.3 V |

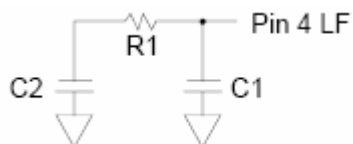
Input Frequency Selection Table

| FS1 | FS0 | Input (MHz) | Output Frequency Scaling (MHz) | | | Modulation Rate (KHz) |
|-----|-----|-------------|--------------------------------|-----------|------------|-----------------------|
| | | | P2781X | P2782X | P2784X | |
| 0 | 0 | 3 to 9 | 3 to 9 | 6 to 18 | 12 to 36 | Fin / 128 |
| 0 | 1 | 10 to 19 | 10 to 19 | 20 to 38 | 40 to 76 | Fin / 256 |
| 1 | 0 | 20 to 38 | 20 to 38 | 40 to 76 | 80 to 152 | Fin / 512 |
| 1 | 1 | 39 to 78 | 39 to 78 | 78 to 156 | 156 to 312 | Fin / 1024 |



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Loop Filter Selection Table VDD 3.3V



Contact Alliance for loop values that are not listed in the table and for component selection values for industrial and automotive temperatures.

| Input MHz | FS1 | FS0 | BW = ±0.50% ¹ | | | BW = ±0.75% ¹ | | | BW = ±1.00% ¹ | | | BW = ±1.25% ¹ | | |
|--------------|-----|-----|--------------------------|------------|-------------|--------------------------|------------|-------------|--------------------------|------------|-------------|--------------------------|------------|-------------|
| | | | C1 (pF) | C2 (pF) | R1 (ohm) | C1 (pF) | C2 (pF) | R1 (ohm) | C1 (pF) | C2 (pF) | R1 (ohm) | C1 (pF) | C2 (pF) | R1 (ohm) |
| 3 | 0 | 0 | 270 | 330,000 | 220 | 270 | 330,000 | 300 | 270 | 100,000 | 390 | 560 | 100,000 | 510 |
| 4 | 0 | 0 | 270 | 100,000 | 270 | 270 | 100,000 | 390 | 270 | 100,000 | 560 | 560 | 100,000 | 680 |
| 5 | 0 | 0 | 270 | 100,000 | 390 | 270 | 100,000 | 560 | 270 | 100,000 | 750 | 560 | 100,000 | 910 |
| 6 | 0 | 0 | 270 | 100,000 | 510 | 270 | 100,000 | 750 | 270 | 10,000 | 1,000 | 680 | 6,800 | 1,200 |
| 7 | 0 | 0 | 270 | 100,000 | 620 | 270 | 100,000 | 1,000 | 270 | 5,600 | 1,200 | 330 | 3,300 | 1,200 |
| 8 | 0 | 0 | 270 | 100,000 | 820 | 270 | 100,000 | 1,200 | 270 | 12,000 | 2,200 | 680 | 6,800 | 2,200 |
| 9 | 0 | 0 | 270 | 100,000 | 1,000 | 270 | 100,000 | 1,500 | 270 | 5,600 | 2,200 | 270 | 2,700 | 2,200 |
| 10 | 0 | 1 | 270 | 100,000 | 330 | 270 | 100,000 | 510 | 270 | 100,000 | 750 | 560 | 100,000 | 910 |
| 11 | 0 | 1 | 270 | 100,000 | 390 | 270 | 100,000 | 560 | 270 | 100,000 | 866(1%) | 560 | 100,000 | 1,100 |
| 12 | 0 | 1 | 270 | 100,000 | 510 | 270 | 100,000 | 750 | 270 | 10,000 | 1,000 | 680 | 6,800 | 1,200 |
| 13 | 0 | 1 | 270 | 100,000 | 560 | 270 | 100,000 | 820 | 270 | 12,000 | 1,200 | 470 | 4,700 | 1,200 |
| 14 | 0 | 1 | 270 | 100,000 | 620 | 270 | 100,000 | 1,000 | 270 | 5,600 | 1,200 | 330 | 3,300 | 1,200 |
| 15 | 0 | 1 | 270 | 100,000 | 750 | 270 | 100,000 | 1,100 | 270 | 3,900 | 1,200 | 330 | 3,300 | 1,500 |
| 16 | 0 | 1 | 270 | 100,000 | 820 | 270 | 100,000 | 1,200 | 270 | 12,000 | 2,200 | 680 | 6,800 | 2,200 |
| 17 | 0 | 1 | 270 | 100,000 | 910 | 270 | 100,000 | 1,300 | 270 | 10,000 | 2,200 | 390 | 3,900 | 2,200 |
| 18 | 0 | 1 | 270 | 100,000 | 1,000 | 270 | 100,000 | 1,500 | 270 | 5,600 | 2,200 | 270 | 2,700 | 2,200 |
| 19 | 0 | 1 | 270 | 100,000 | 1,200 | 270 | 100,000 | 1,600 | 270 | 3,300 | 2,200 | 270 | 2,700 | 2,700 |
| 20 | 0 | 0 | 270 | 100,000 | 330 | 270 | 100,000 | 560 | 270 | 100,000 | 750 | 560 | 100,000 | 910 |
| 21-22 | 1 | 0 | 270 | 100,000 | 390 | 270 | 100,000 | 620 | 270 | 100,000 | 866 (1%) | 560 | 100,000 | 1,100 |
| 23-24 | 1 | 0 | 270 | 100,000 | 510 | 270 | 100,000 | 750 | 270 | 10,000 | 1,000 | 680 | 6,800 | 1,200 |
| 25-26 | 1 | 0 | 270 | 100,000 | 560 | 270 | 100,000 | 820 | 270 | 12,000 | 1,200 | 470 | 4,700 | 1,200 |
| 27-28 | 1 | 0 | 270 | 100,000 | 620 | 270 | 100,000 | 1,000 | 270 | 6,800 | 1,200 | 330 | 3,300 | 1,200 |
| 29-30 | 1 | 0 | 270 | 100,000 | 750 | 270 | 100,000 | 1,100 | 270 | 3,900 | 1,200 | 330 | 3,300 | 1,500 |
| 31-32 | 1 | 0 | 270 | 100,000 | 820 | 270 | 100,000 | 1,200 | 270 | 12,000 | 2,200 | 680 | 6,800 | 2,200 |
| 33-34 | 1 | 0 | 270 | 100,000 | 910 | 270 | 100,000 | 1,300 | 270 | 10,000 | 2,200 | 390 | 3,900 | 2,200 |
| 35-36 | 1 | 0 | 270 | 100,000 | 1,000 | 270 | 100,000 | 1,500 | 270 | 5,600 | 2,200 | 270 | 2,700 | 2,200 |
| 37-38 | 1 | 0 | 270 | 100,000 | 1,200 | 270 | 100,000 | 1,600 | 270 | 3,300 | 2,200 | 270 | 2,700 | 2,700 |
| 39-42 | 1 | 1 | 270 | 100,000 | 330 | 270 | 100,000 | 560 | 270 | 100,000 | 750 | 560 | 100,000 | 910 |
| 43-46 | 1 | 1 | 270 | 100,000 | 390 | 270 | 100,000 | 620 | 270 | 100,000 | 866 (1%) | 560 | 100,000 | 1,100 |
| 47-50 | 1 | 1 | 270 | 100,000 | 510 | 270 | 100,000 | 750 | 270 | 10,000 | 1,000 | 680 | 6,800 | 1,200 |
| 51-54 | 1 | 1 | 270 | 100,000 | 560 | 270 | 100,000 | 820 | 270 | 12,000 | 1,200 | 470 | 4,700 | 1,200 |
| 55-58 | 1 | 1 | 270 | 100,000 | 620 | 270 | 100,000 | 1,000 | 270 | 6,800 | 1,200 | 330 | 3,300 | 1,200 |
| 59-62 | 1 | 1 | 270 | 100,000 | 750 | 270 | 100,000 | 1,100 | 270 | 3,900 | 1,200 | 330 | 3,300 | 1,500 |
| 63-66 | 1 | 1 | 270 | 100,000 | 820 | 270 | 100,000 | 1,200 | 270 | 12,000 | 2,200 | 680 | 6,800 | 2,200 |
| 67-70 | 1 | 1 | 270 | 100,000 | 910 | 270 | 100,000 | 1,300 | 270 | 8,200 | 2,200 | 390 | 3,900 | 2,200 |
| 71-74 | 1 | 1 | 270 | 100,000 | 1,000 | 270 | 100,000 | 1,600 | 270 | 5,600 | 2,200 | 270 | 2,700 | 2,200 |
| 75-78 | 1 | 1 | 270 | 100,000 | 1,200 | 270 | 100,000 | 1,800 | 270 | 3,300 | 2,200 | 270 | 2,700 | 2,700 |

¹ The BW value is representative of typical conditions

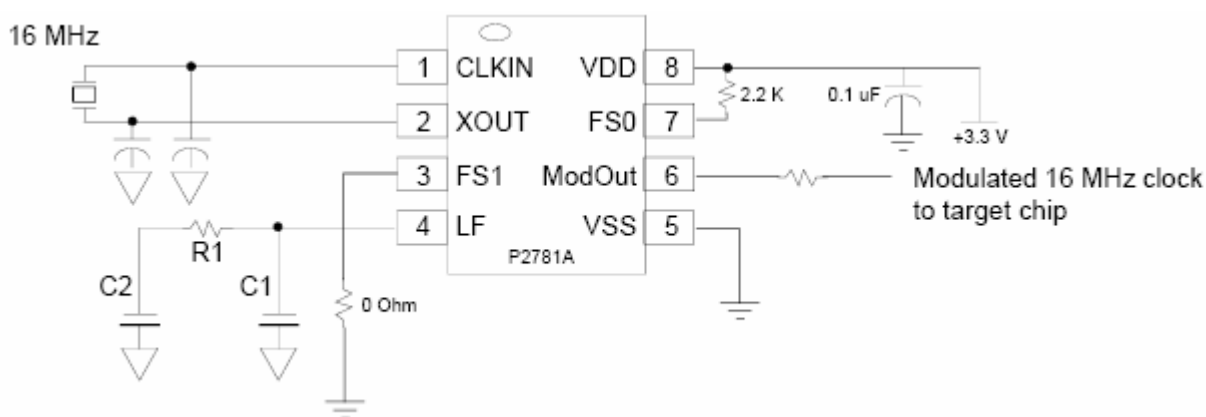


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Spread Spectrum Selection

The P278xA performs Zero Cycle Slip when set at low percentage spreading. This allows no occurrence of system timing error. The optimal setting should minimize system EMI to the fullest without affecting system performance. The spreading is described as a percentage deviation of the center frequency. (Note: the center frequency is the frequency of the external reference input on CLKIN, Pin 1.)

The P2781A is designed for PC peripheral, networking, notebook PC, and LCD monitor applications. It is optimized for operation between 3 to 78 MHz range. In the following application schematic example, the P2781A spread percentage selection is determined by the external LF value specified in the Loop Filter Selection Table. The Input Frequency Selection Table specifies the input frequency range. The external LF allows the user to fine tune the spread percentage to optimize the EMI reduction benefits of the spread spectrum.



Note: Both logic input pins FS1 and FS0 have to be connected to either VDD or VSS. Do not leave them floating.



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Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|------------------|----------------------------------------|---------------|------|
| V_{DD}, V_{IN} | Voltage on any pin with respect to GND | -0.5 to + 7.0 | V |
| T_{STG} | Storage temperature | -65 to +125 | °C |
| T_A | Operating temperature | 0 to +70 | °C |

DC Electrical Characteristics

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------|---------------------------------------------------------------------|--------------|-----|----------------|------|
| V_{IL} | Input low voltage | GND – 0.3 | – | 0.8 | V |
| V_{IH} | Input high voltage | 2.0 | – | $V_{DD} + 0.3$ | V |
| I_{IL} | Input low current (internal input pull-up resistor on FS0 and FS1) | – | 60 | – | μA |
| I_{IH} | Input high current (internal input pull-up resistor on FS0 and FS1) | – | 0 | – | μA |
| I_{XOL} | XOUT output low current | – | 10 | – | mA |
| I_{XOH} | XOUT output high current | – | 10 | – | mA |
| V_{OL} | Output low voltage ($V_{DD} = 3.3$ V, $I_{OL} = 20$ mA) | – | – | 0.4 | V |
| V_{OH} | Output high voltage ($V_{DD} = 3.3$ V, $I_{OH} = 20$ mA) | 2.5 | – | – | V |
| I_{DD} | Static supply current | – | 3 | – | mA |
| I_{CC} | Typical dynamic supply current (25 pF scope probe loading) | 5.2 at 3 MHz | – | 21.2 at 82 MHz | mA |
| V_{DD} | Operating voltage | 3.0 | 3.3 | 3.6 | V |

AC Electrical Characteristics

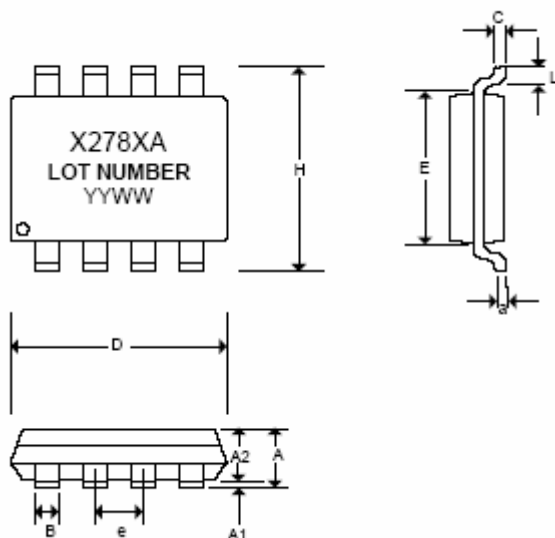
| Symbol | Parameter | Min | Typ | Max | Unit |
|----------------------|--------------------------------------------------------------------------------------------------|------------------|-----------|-------------------|------|
| f_{IN} | Input frequency: P278XX | 3 | | 78 | MHz |
| f_{OUT} | Output frequency: P2781X P2782X P2784X | 3 6 12 | | 78 156 312 | MHz |
| t_{LH} P278XX | Output rise time (measured at 0.8 V to 2.0 V, 25 pF scope probe loading) | | 1 | | ns |
| t_{HL} P278XX | Output fall time (measured at 2.0 V to 0.8 V, 25 pF scope probe loading) | | 1 | | ns |
| t_{JC} P2781X | Jitter (cycle to cycle, $\pm 6\sigma$, 1000 sweeps, $\pm 0.5\%$ spread, I/O frequency = 16 MHz) | | ± 250 | | ps |
| t_D P2781X | Output duty cycle deviation (error from 50% duty cycle, 25 pF scope probe loading) | ± 1 at 3 MHz | | ± 2 at 82 MHz | % |
| ΔF P278XX | Frequency deviation tolerance from BW% stated in the Loop Filter Selection Table | -20 | 0 | +20 | % |



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Package Information

Mechanical Package Outline 8-Pin SOIC



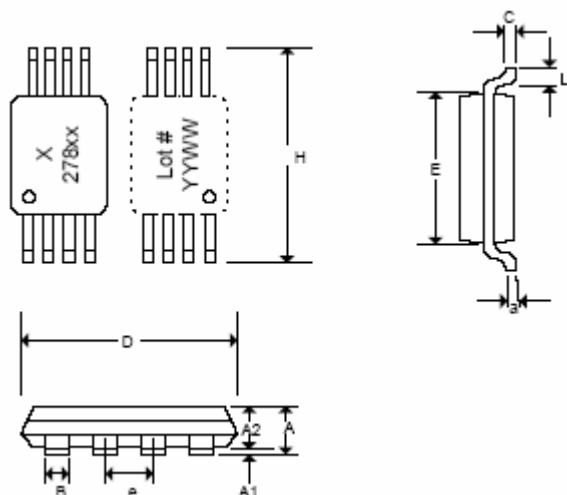
| Symbol | Dimensions in inches | | | Dimensions in millimeters | | |
|--------|----------------------|-------|-------|---------------------------|------|------|
| | Min | Nor | Max | Min | Nor | Max |
| A | 0.057 | 0.064 | 0.071 | 1.45 | 1.63 | 1.80 |
| A1 | 0.004 | 0.007 | 0.010 | 0.10 | 0.18 | 0.25 |
| A2 | 0.053 | 0.061 | 0.069 | 1.35 | 1.55 | 1.75 |
| B | 0.012 | 0.016 | 0.020 | 0.31 | 0.41 | 0.51 |
| C | 0.004 | 0.006 | 0.01 | 0.10 | 0.15 | 0.25 |
| D | 0.186 | 0.194 | 0.202 | 4.72 | 4.92 | 5.12 |
| E | 0.148 | 0.156 | 0.164 | 3.75 | 3.95 | 4.15 |
| e | 0.050 BSC | | | 1.27 BSC | | |
| H | 0.224 | 0.236 | 0.248 | 5.70 | 6.00 | 6.30 |
| L | 0.012 | 0.020 | 0.028 | 0.30 | 0.50 | 0.70 |
| a | 0° | 5° | 8° | 0° | 5° | 8° |

Note: Controlling dimensions are millimeters
SOIC - 0.074 grams unit weight



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Mechanical Package Outline 8-Pin TSSOP



| Symbol | Dimensions in inches | | | Dimensions in millimeters | | |
|--------|----------------------|-------|-------|---------------------------|------|------|
| | Min | Nor | Max | Min | Nor | Max |
| A | | | 0.047 | | | 1.10 |
| A1 | 0.002 | | 0.006 | 0.05 | | 0.15 |
| A2 | 0.031 | 0.039 | 0.041 | 0.80 | 1.00 | 1.05 |
| B | 0.007 | | 0.012 | 0.19 | | 0.30 |
| C | 0.004 | | 0.008 | 0.09 | | 0.20 |
| D | 0.114 | 0.118 | 0.122 | 2.90 | 3.00 | 3.10 |
| E | 0.169 | 0.173 | 0.177 | 4.30 | 4.40 | 4.50 |
| e | 0.026 BSC | | | 0.65 BSC | | |
| H | 0.244 | 0.252 | 0.260 | 6.20 | 6.40 | 6.60 |
| L | 0.018 | 0.024 | 0.030 | 0.45 | 0.60 | 0.75 |
| a | 0° | 5° | 8° | 0° | 5° | 8° |

Note: Controlling dimensions are millimeters
TSSOP -0.034 grams unit weight

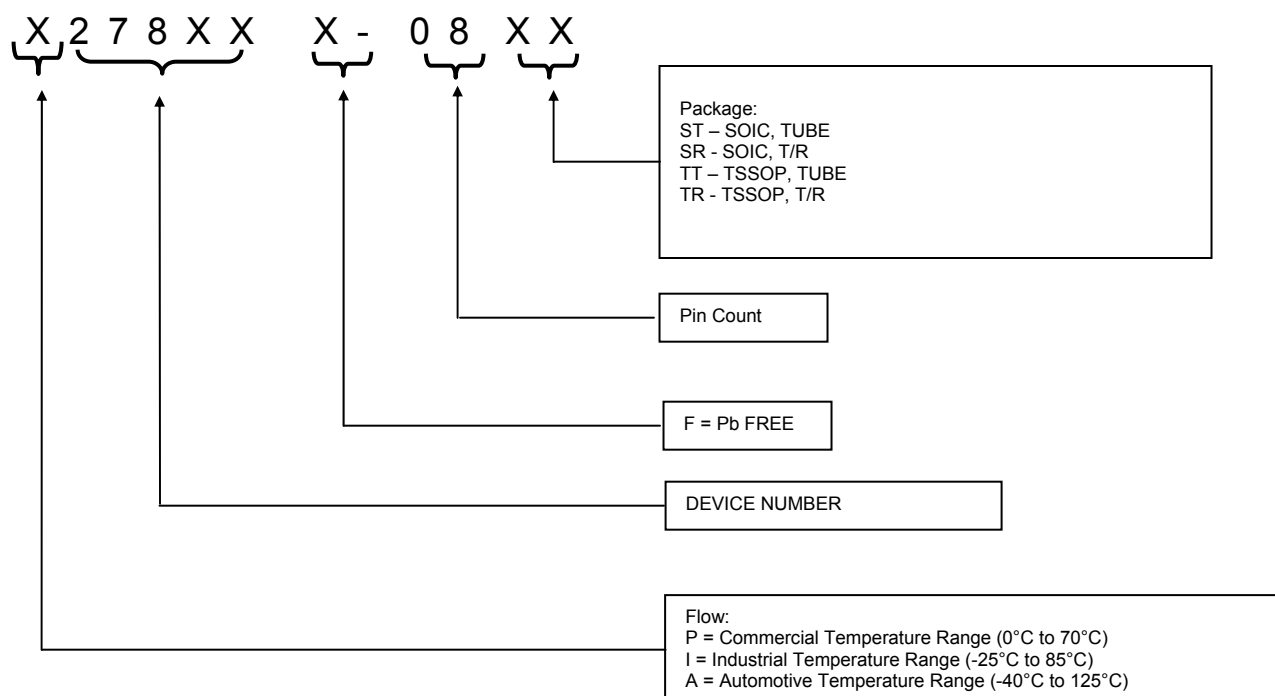


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Ordering Codes

| Ordering Number | Marking | Package Type | QTY / Reel | Temperature |
|-----------------|---------|--------------------------|------------|-------------|
| X278XA-08ST | X278XA | 8 PIN SOIC, TUBE | | See flow |
| X278XA-08SR | X278XA | 8 PIN SOIC, TAPE & REEL | 2,500 | See flow |
| X278XA-08TT | X278XA | 8 PIN TSSOP, TUBE | | See flow |
| X278XA-08TR | X278XA | 8 PIN TSSOP, TAPE & REEL | 2,500 | See flow |
| X278XB-08TT | X278XB | 8 PIN TSSOP, TUBE | | See flow |
| X278XB-08TR | X278XB | 8 PIN TSSOP, TAPE & REEL | 2,500 | See flow |

Device Ordering Information





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