



General Purpose EMI Reduction IC

Features

- Provides up to 15dB 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 78MHz
- 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
- P278XA is available in 8 pin SOIC and TSSOP Packages
- Available for industrial and automotive temperature ranges.

Product Description

The P278xA is a versatile spread spectrum frequency modulator designed specifically for digital camera and

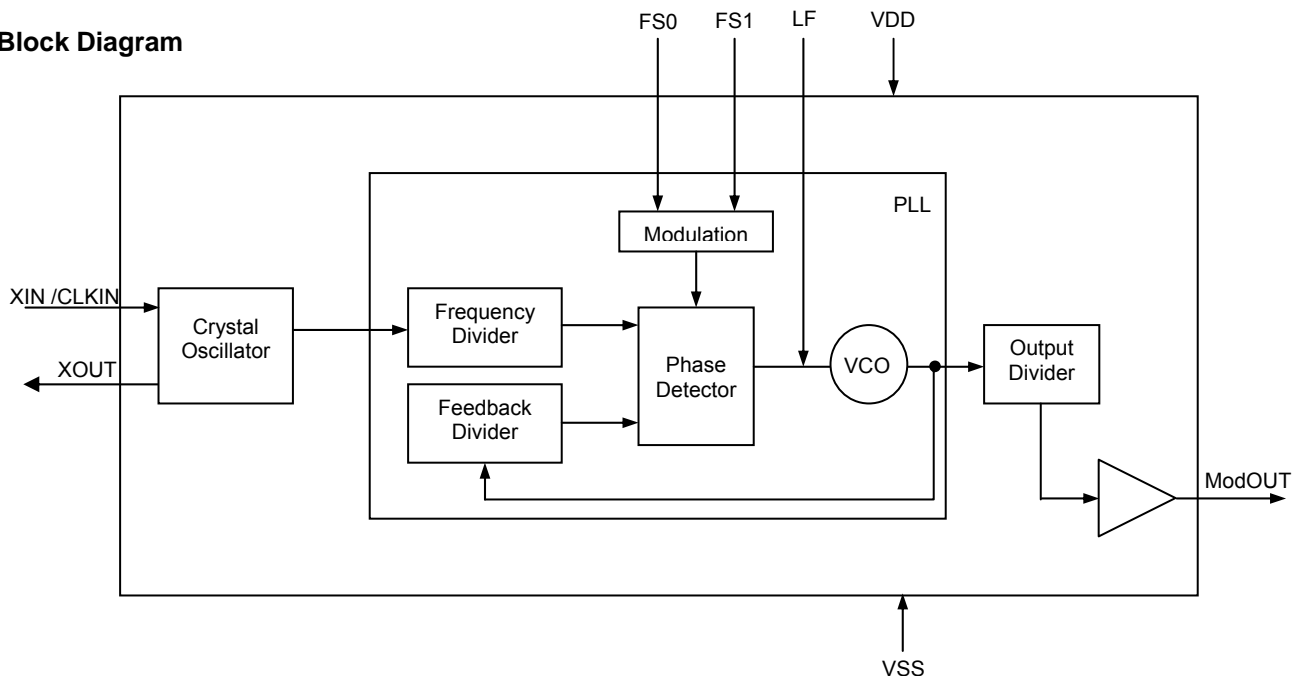
other digital video and imaging applications. The P278xA reduces electromagnetic interference (EMI) at the clock source, which provides system wide reduction of EMI of all clock dependent signals. The P278xA allows significant system cost savings by reducing the number of circuit board layers and shielding that are traditionally required to pass EMI regulations.

The P278xA uses the most efficient and optimized modulation profile approved by the FCC. The P278xA 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 P278xA is targeted towards MFP, xDSL, fax modem, set-top box, USB controller, DSC, and embedded systems.

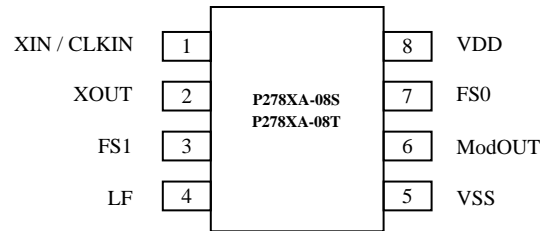
Block Diagram





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Pin Configuration



Standard pin Configuration offered in both
8 pin SOIC and TSSOP Packages

Pin Description (P278XA)

| Pin# | Pin Name | Type | Description |
|------|-----------|------|--|
| 1 | XIN/CLKIN | I | Connect to crystal or clock input. This pin has dual functions. It can be connected either to an external crystal or an external reference clock. |
| 2 | XOUT | O | Crystal connection. If using an external reference, this pin must be left unconnected. |
| 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 |

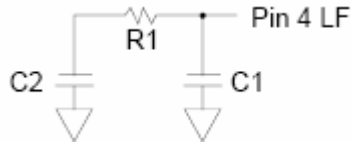
Input Frequency Selection Table

| FS1 | FS0 | Input (MHz) | Output Frequency Scaling (MHz) | | | Modulation Rate (KHz) |
|-----|-----|-------------|--------------------------------|-----------|------------|-----------------------|
| | | | P2781A | P2782A | P2784A | |
| 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



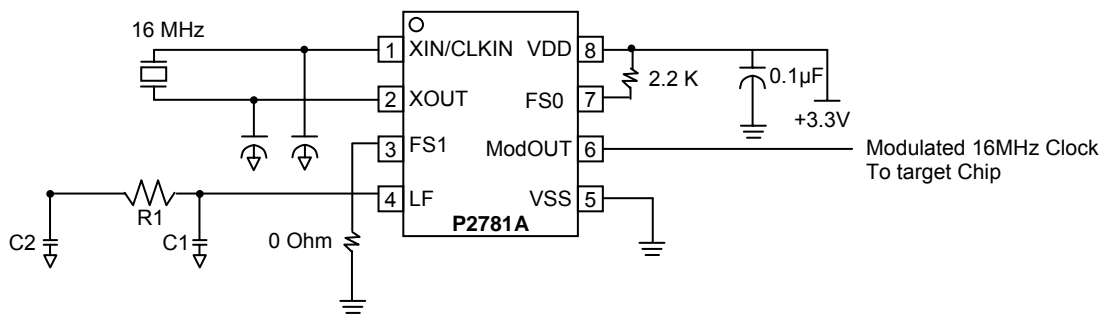
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Spread Spectrum Selection

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 78MHz 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 |
|-----------------|---|--------------------------|------|
| VDD | Supply voltage, DC | (VSS – 0.5) to 7 | V |
| V _I | Input voltage, DC | (VSS-0.5) to (VDD+0.5) | V |
| V _O | Output voltage, DC | (VSS-0.5) to (VDD + 0.5) | V |
| I _{IK} | Input clamp current (V _I <0 or V _I >VDD) | -50 to +50 | mA |
| I _{OK} | Output clamp current (V _I <0 or V _I >VDD) | -50 to +50 | mA |
| T _S | Storage temperature | -65 to +125 | °C |
| T _A | Ambient temperature range, under bias | -55 to 125 | °C |
| T _J | Junction temperature | 150 | °C |
| | Lead temperature (soldering 10 sec) | 260 | °C |
| | Input static discharge voltage protection (As per JEDEC STD22- A114-B) | 2 | kV |

Note: These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for extended periods may affect device reliability.

DC Electrical Characteristics

(Test condition: All parameters are measured at room temperature (+25°C) unless otherwise stated)

| Symbol | Parameter | Min | Typ | Max | Unit |
|------------------|--|-------------|-----|---------------|------|
| V _{IL} | Input low voltage | VSS – 0.3 | - | 0.8 | V |
| V _{IH} | Input high voltage | 2.0 | - | VDD +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) | - | 60 | - | μA |
| I _{XOL} | XOUT output low current | - | 10 | - | mA |
| I _{XOH} | XOUT output high current | - | 10 | - | mA |
| V _{OL} | Output low voltage (VDD = 3.3V, I _{OL} = 20mA) | - | - | 0.4 | V |
| V _{OH} | Output high voltage (VDD = 3.3V, I _{OH} = 20mA) | 2.5 | - | - | V |
| I _{DD} | Static supply current | - | 3 | - | mA |
| I _{CC} | Typical dynamic supply current (25pF scope probe loading) | 5.2 at 3MHz | - | 21.2 at 82MHz | mA |
| VDD | Operating voltage | 3.0 | 3.3 | 3.6 | V |



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AC Electrical Characteristics

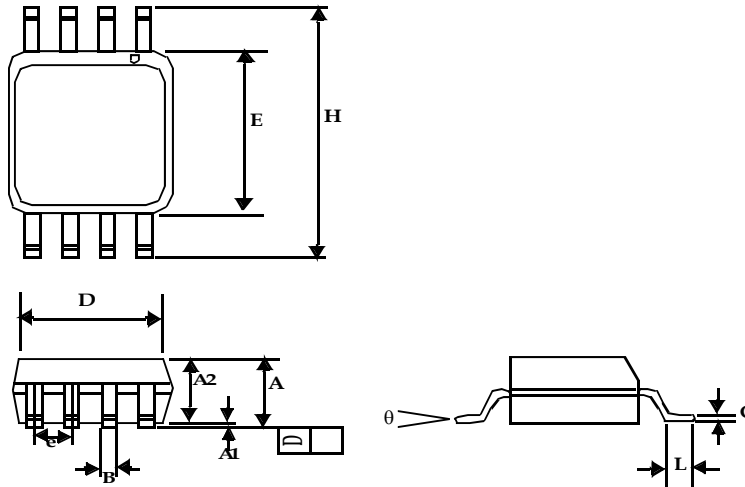
| Symbol | Parameter | | Min | Typ | Max | Unit |
|----------------------|--|----------------------------|-----------------|-----------|------------------|------|
| f_{IN} | Input frequency: P278XA | | 3 | - | 78 | MHz |
| f_{OUT} | Output frequency: | P2781A P2782A P2784A | 3 6 12 | - | 78 156 312 | MHz |
| t_{LH} P278XA | Output rise time (measured at 0.8 V to 2.0 V, 25pF scope probe loading) | | - | 1 | - | nS |
| t_{HL} P278XA | Output fall time (measured at 2.0 V to 0.8 V, 25 pF scope probe loading) | | - | 1 | - | nS |
| t_{JC} P2781A | Jitter (cycle to cycle, $\pm 6\sigma$, 1000 sweeps, $\pm 0.5\%$ spread, I/O frequency = 16MHz) | | - | ± 250 | - | pS |
| t_D P2781A | Output duty cycle deviation (error from 50% duty cycle, 25pF scope probe loading) | | ± 1 at 3MHz | - | ± 2 at 82MHz | % |
| ΔF P278XA | 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 Package

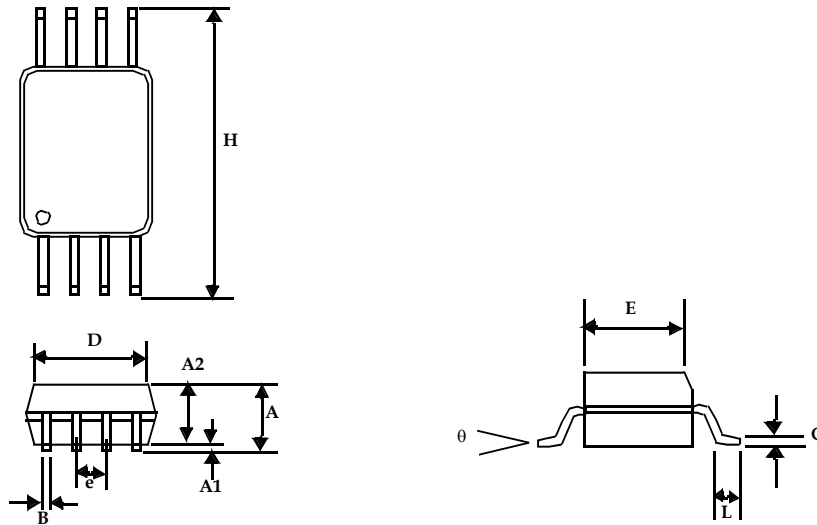


| Symbol | Dimensions | | | |
|--------|------------|-------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A1 | 0.004 | 0.010 | 0.10 | 0.25 |
| A | 0.053 | 0.069 | 1.35 | 1.75 |
| A2 | 0.049 | 0.059 | 1.25 | 1.50 |
| B | 0.012 | 0.020 | 0.31 | 0.51 |
| C | 0.007 | 0.010 | 0.18 | 0.25 |
| D | 0.193 BSC | | 4.90 BSC | |
| E | 0.154 BSC | | 3.91 BSC | |
| e | 0.050 BSC | | 1.27 BSC | |
| H | 0.236 BSC | | 6.00 BSC | |
| L | 0.016 | 0.050 | 0.41 | 1.27 |
| θ | 0° | 8° | 0° | 8° |

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



Mechanical Package Outline 8-Pin TSSOP Package



| Symbol | Dimensions | | | |
|--------|------------|-------|-------------|------|
| | Inches | | Millimeters | |
| | Min | Max | Min | Max |
| A | | 0.043 | | 1.10 |
| A1 | 0.002 | 0.006 | 0.05 | 0.15 |
| A2 | 0.033 | 0.037 | 0.85 | 0.95 |
| B | 0.008 | 0.012 | 0.19 | 0.30 |
| c | 0.004 | 0.008 | 0.09 | 0.20 |
| D | 0.114 | 0.122 | 2.90 | 3.10 |
| E | 0.169 | 0.177 | 4.30 | 4.50 |
| e | 0.026 BSC | | 0.65 BSC | |
| H | 0.252 BSC | | 6.40 BSC | |
| L | 0.020 | 0.028 | 0.50 | 0.70 |
| θ | 0° | 8° | 0° | 8° |

Note: Controlling dimensions are millimeters
TSSOP - 0.0325 grams unit weight



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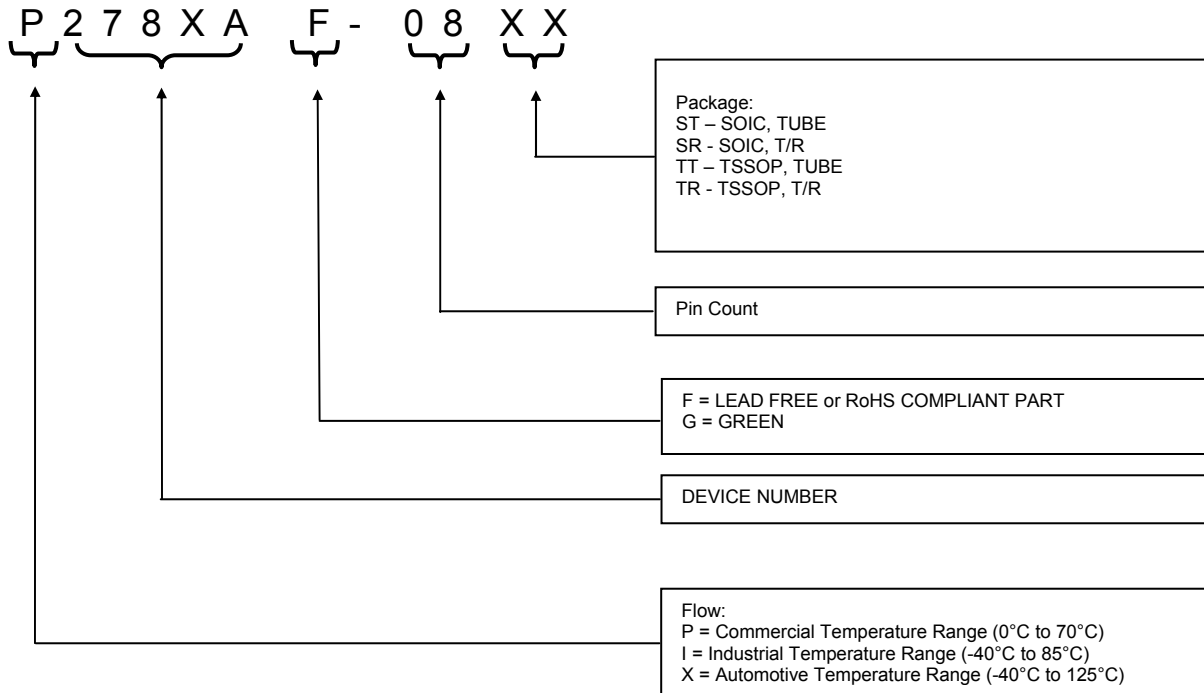
Ordering Codes

| Ordering # | Marking | Package Type | QTY / Reel | Temperature |
|--------------|---------|-------------------------------------|------------|-------------|
| P278XA-08ST | P278XA | 8 PIN SOIC, TUBE | | See flow |
| P278XA-08SR | P278XA | 8 PIN SOIC, TAPE & REEL | 2,500 | See flow |
| P278XA-08TT | P278XA | 8 PIN TSSOP, TUBE | | See flow |
| P278XA-08TR | P278XA | 8 PIN TSSOP, TAPE & REEL | 2,500 | See flow |
| P278XAF-08ST | P278XAF | 8 PIN SOIC, TUBE, Pb Free | | See flow |
| P278XAF-08SR | P278XAF | 8 PIN SOIC, TAPE AND REEL, Pb Free | 2,500 | See flow |
| P278XAF-08TT | P278XAF | 8 PIN TSSOP, TUBE, Pb Free | | See flow |
| P278XAF-08TR | P278XAF | 8 PIN TSSOP, TAPE AND REEL, Pb Free | 2,500 | See flow |
| P278XAG-08ST | P278XAG | 8 PIN SOIC, TUBE, Green | | See flow |
| P278XAG-08SR | P278XAG | 8 PIN SOIC, TAPE AND REEL, Green | 2,500 | See flow |
| P278XAG-08TT | P278XAG | 8 PIN TSSOP, TUBE, Green | | See flow |
| P278XAG-08TR | P278XAG | 8 PIN TSSOP, TAPE AND REEL, Green | 2,500 | See flow |
| I278XA-08ST | I278XA | 8 PIN SOIC, TUBE | | See flow |
| I278XA-08SR | I278XA | 8 PIN SOIC, TAPE & REEL | 2,500 | See flow |
| I278XA-08TT | I278XA | 8 PIN TSSOP, TUBE | | See flow |
| I278XA-08TR | I278XA | 8 PIN TSSOP, TAPE & REEL | 2,500 | See flow |
| I278XAF-08ST | I278XAF | 8 PIN SOIC, TUBE, Pb Free | | See flow |
| I278XAF-08SR | I278XAF | 8 PIN SOIC, TAPE AND REEL, Pb Free | 2,500 | See flow |
| I278XAF-08TT | I278XAF | 8 PIN TSSOP, TUBE, Pb Free | | See flow |
| I278XAF-08TR | I278XAF | 8 PIN TSSOP, TAPE AND REEL, Pb Free | 2,500 | See flow |
| I278XAG-08ST | I278XAG | 8 PIN SOIC, TUBE, Green | | See flow |
| I278XAG-08SR | I278XAG | 8 PIN SOIC, TAPE AND REEL, Green | 2,500 | See flow |
| I278XAG-08TT | I278XAG | 8 PIN TSSOP, TUBE, Green | | See flow |
| I278XAG-08TR | I278XAG | 8 PIN TSSOP, TAPE AND REEL, Green | 2,500 | See flow |
| 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 |
| X278XAF-08ST | X278XAF | 8 PIN SOIC, TUBE, Pb Free | | See flow |
| X278XAF-08SR | X278XAF | 8 PIN SOIC, TAPE AND REEL, Pb Free | 2,500 | See flow |
| X278XAF-08TT | X278XAF | 8 PIN TSSOP, TUBE, Pb Free | | See flow |
| X278XAF-08TR | X278XAF | 8 PIN TSSOP, TAPE AND REEL, Pb Free | 2,500 | See flow |
| X278XAG-08ST | X278XAG | 8 PIN SOIC, TUBE, Green | | See flow |
| X278XAG-08SR | X278XAG | 8 PIN SOIC, TAPE AND REEL, Green | 2,500 | See flow |
| X278XAG-08TT | X278XAG | 8 PIN TSSOP, TUBE, Green | | See flow |
| X278XAG-08TR | X278XAG | 8 PIN TSSOP, TAPE AND REEL, Green | 2,500 | See flow |



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Device Ordering Information



Licensed under US patent #5,488,627, #6,646,463 and #5,631,920



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Note: This product utilizes US Patent # 6,646,463 Impedance Emulator Patent issued to Alliance Semiconductor, dated 11-11-2003

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