

Features

- 6 Bit Digital Phase Shifter
- 360° Coverage with LSB = 5.6°
- Integrated CMOS Driver
- Serial or Parallel Control
- Low RMS Phase Error: 2°
- Minimal Attenuation Variation over Phase Shift Range
- Low RMA Attenuation Error: 0.4 dB
- EAR99
- Lead-Free 4 mm 24-Lead PQFN Package
- RoHS* Compliant

Description

The MAPS-011007 is a GaAs pHEMT 6-bit digital phase shifter with an integrated CMOS driver in a 4 mm PQFN plastic surface mount package. Step size is 5.6° providing phase shift from 0° to 360° in 5.6° steps. This design has been optimized to minimize variation in attenuation over the phase shift range.

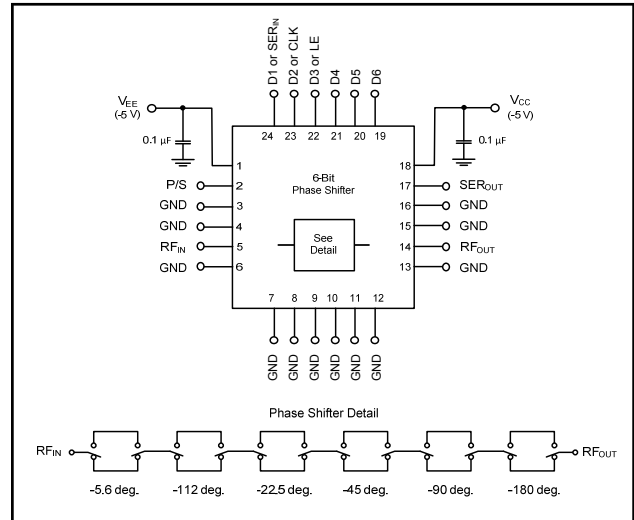
The MAPS-011007 is ideally suited for use where high phase accuracy with minimum loss variation over the phase shift range are required. The 4 mm PQFN package provides a smaller footprint than is typically available for a digital phase shifter with an internal driver. Typical applications include communications antennas and phased array radars.

Ordering Information ¹

| Part Number | Package |
|--------------------|-------------------|
| MAPS-011007 | Bulk |
| MAPS-011007-TR0500 | 500 piece reel |
| MAPS-011007-001SMB | Sample Test Board |

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration ²

| Pin No. | Function | Pin No. | Function |
|---------|----------|---------|--------------|
| 1 | VEE | 13 | GND |
| 2 | P/S | 14 | RF OUT |
| 3 | GND | 15 | GND |
| 4 | GND | 16 | GND |
| 5 | RF IN | 17 | SER OUT |
| 6 | GND | 18 | VCC |
| 7 | GND | 19 | D6 |
| 8 | GND | 20 | D5 |
| 9 | GND | 21 | D4 |
| 10 | GND | 22 | D3 or LE |
| 11 | GND | 23 | D2 or CLK |
| 12 | GND | 24 | D1 or SER IN |

2. The exposed pad centered on the package bottom must be connected to RF and DC ground.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

Digital Phase Shifter 6-Bit, 1.2 - 1.4 GHz

Rev. V2

Electrical Specifications:

Freq. = 1.2 - 1.4 GHz, $T_A = 25^\circ\text{C}$, $Z_0 = 50 \Omega$, $V_{CC} = +5.0 \text{ V}$, $V_{EE} = -5.0 \text{ V}$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|--|---|-------|-----------------------|----------------|----------------------------|
| Operating Power ³ | 1.2 - 1.4 GHz | dBm | — | — | +25 |
| Insertion Loss (Any Phase State) | Any Phase State | dB | — | 3.8 | 5.4 |
| Attenuation Variation | Across All Phase States | dB | — | ± 0.5 | — |
| RMS Attenuation Error ⁴ | All Values Relative to Insertion Loss at Reference Phase | dB | — | 0.4 | — |
| RMS Phase Error ⁴ | All Values Relative to Reference Phase | deg | — | 2 | — |
| Phase Accuracy Relative to Reference Loss State | 5.6 Degree Bit | deg | — | ± 0.5 | — |
| | 11.2 Degree Bit | | — | ± 0.3 | — |
| | 22.5 Degree Bit | | — | ± 1 | — |
| | 45 Degree Bit | | — | ± 2 | — |
| | 90 Degree Bit | | — | ± 2 | — |
| | 180 Degree Bit | | — | ± 1 | — |
| | Sum of All Bits | | — | ± 4 | — |
| VSWR | RF IN RF OUT | Ratio | — — | 1.4:1 1.4:1 | — — |
| 1 dB Compression | Reference State | dBm | — | 30 | — |
| Input IP3 | Two-tone inputs up to +5 dBm | dBm | — | 48 | — |
| T_{RISE} , T_{FALL} | 10% to 90% RF, 90% to 10% RF | ns | — | 50 | — |
| V_{CC} V_{EE} | — — | V | 3.0 -5.5 | — -5.0 | 5.5 -3.0 |
| V_{IL} V_{IH} | LOW-level input voltage HIGH-level input voltage | V | 0.0 0.7 x V_{CC} | — — | 0.3 x V_{CC} V_{CC} |
| I_{IN} (Input Control Current) | $V_{IN} = V_{CC}$ or GND | µA | — | 1 | — |
| V_{OH} V_{OL} | For serial out; $I_{OH} = -100 \mu\text{A}$ For serial out; $I_{OL} = 100 \mu\text{A}$ | V | $V_{CC} - 0.2$ — | — — | — 0.2 |
| I_{CC} (Quiescent Supply Current) | $V_{cntrl} = V_{CC}$ or GND | µA | — | — | 5 |
| I_{EE} | V_{EE} min to max $V_{in} = V_{IL}$ or V_{IH} | mA | -1.0 | -0.1 | — |

3. Maximum operating power is the maximum power where the specifications are guaranteed.

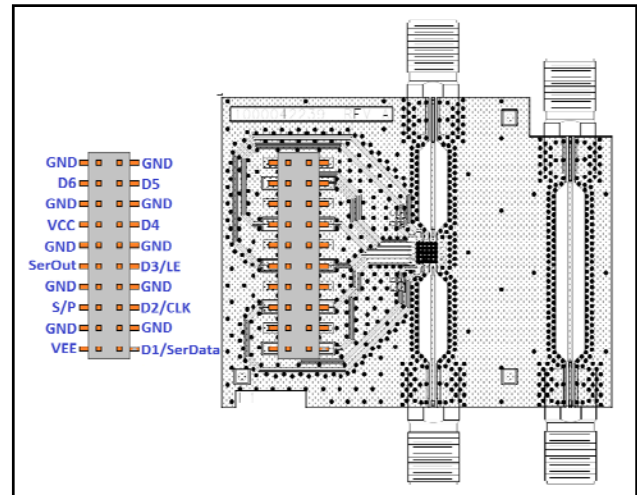
4. RMS is calculated across all 63 amplitude or phase states relative to the amplitude or phase in the 0° phase state at a given frequency.

Absolute Maximum Ratings ^{5,6}

| Parameter | Absolute Maximum |
|----------------------------------|---|
| Input Power 1.2 - 1.4 GHz | +27 dBm |
| V_{CC} | $-0.5V \leq V_{CC} \leq +7.0V$ |
| V_{EE} | $-7.0V \leq V_{EE} \leq +0.5V$ |
| D1-D6, P/S, LE, CLK or SER IN | $-0.5V \leq V_{IN} \leq V_{CC} + 0.5V$ |
| SER OUT | $-0.5V \leq V_{OUT} \leq V_{CC} + 0.5V$ |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +125°C |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.

Sample Board Header Pin Labels



Handling Procedures

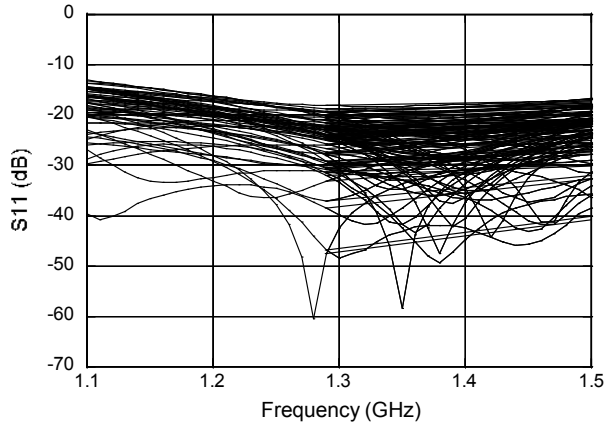
Please observe the following precautions to avoid damage:

Static Sensitivity

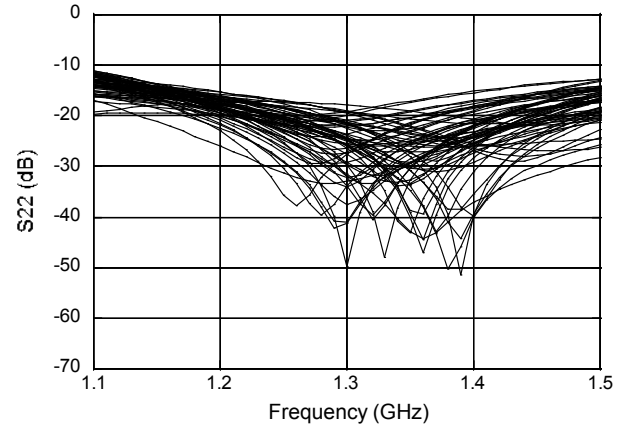
Gallium Arsenide and Silicon Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Performance Curves

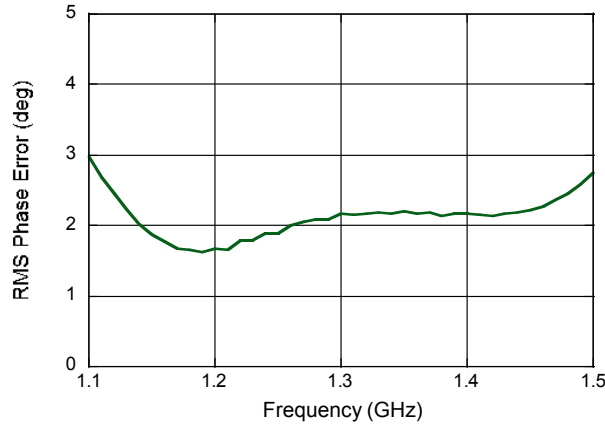
RF_{IN} Return Loss vs. Frequency (All States)



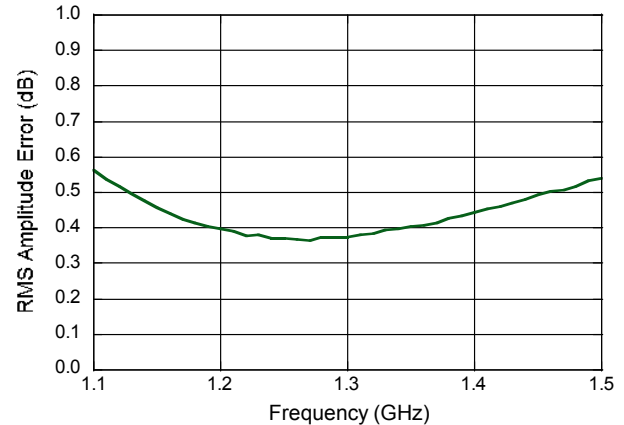
RF_{OUT} Return Loss vs. Frequency (All States)



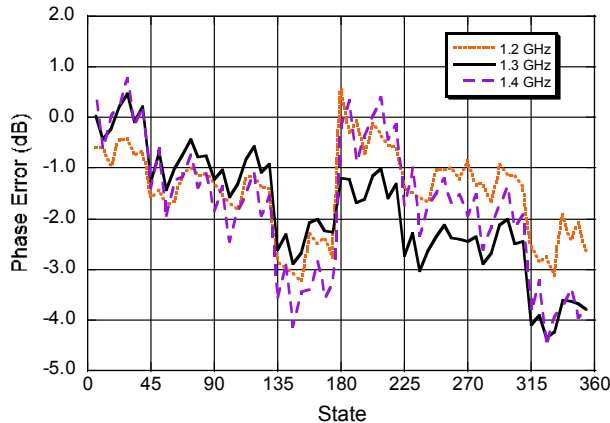
Mean RMS Phase Error vs. Frequency



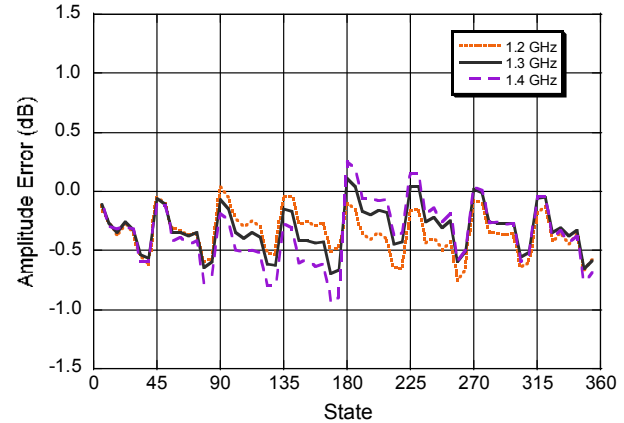
Mean RMS Amplitude Error vs. Frequency



Phase Error (degrees) vs. State



Amplitude Error (dB) vs. State



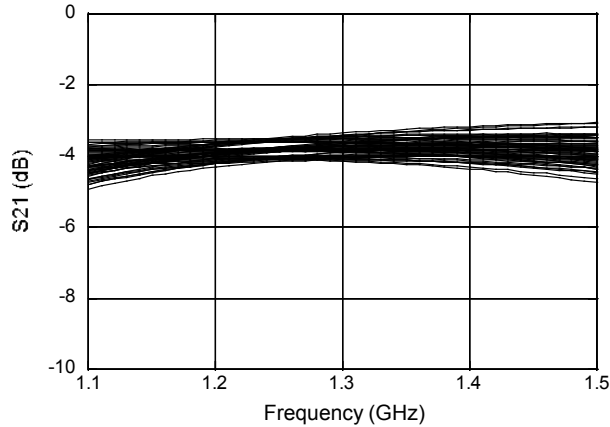
ADVANCED: Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
PRELIMINARY: Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400
 • **India** Tel: +91.80.43537383 • **China** Tel: +86.21.2407.1588
 Visit www.macomtech.com for additional data sheets and product information.

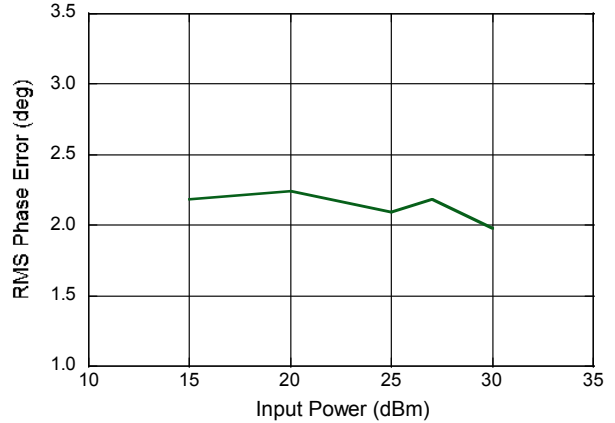
M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Typical Performance Curves

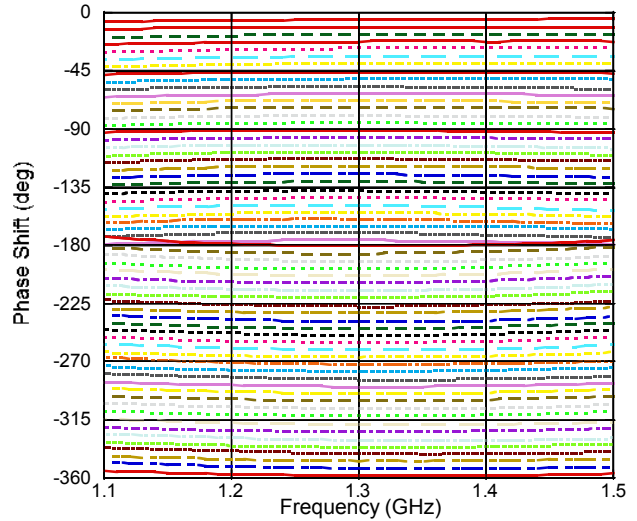
Amplitude Variation vs. Phase State



RMS Phase Error vs. Input Power @ 1.3 GHz



Phase Shift vs. Frequency (All States)



| | | | |
|--------|--------|--------|--------|
| 5.6° | 118.1° | 230.6° | 343.1° |
| 11.2° | 123.7° | 236.2° | 348.7° |
| 16.8° | 129.3° | 241.8° | 354.3° |
| 22.5° | 135° | 247.5° | |
| 28.1° | 140.6° | 253.1° | |
| 33.7° | 146.2° | 258.7° | |
| 39.3° | 151.8° | 264.3° | |
| 45° | 157.5° | 270° | |
| 50.6° | 163.1° | 275.6° | |
| 56.2° | 168.7° | 281.2° | |
| 61.8° | 174.3° | 286.8° | |
| 67.5° | 180° | 292.5° | |
| 73.1° | 185.6° | 298.1° | |
| 78.7° | 191.2° | 303.7° | |
| 84.3° | 196.8° | 309.3° | |
| 90° | 202.5° | 315° | |
| 95.6° | 208.1° | 320.6° | |
| 101.2° | 213.7° | 326.2° | |
| 106.8° | 219.3° | 331.8° | |
| 112.5° | 225° | 337.5° | |

ADVANCED: Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
PRELIMINARY: Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

• **North America** Tel: 800.366.2266 • **Europe** Tel: +353.21.244.6400
 • **India** Tel: +91.80.43537383 • **China** Tel: +86.21.2407.1588
 Visit www.macontech.com for additional data sheets and product information.

M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.

Modes of Operation: Serial and Direct Parallel

Serial Mode

The serial control interface (SERIN, CLK, LE, SEROUT) is compatible with the SPI protocol. SPI mode is activated when P/S is kept high. The 6-bit serial word must be loaded with the MSB first. After shifting in the 6 bit word, a rising edge on LE will set the phase shifter to the desired state. While LE is high the CLK is masked to protect the data while implementing the change. SEROUT is SERIN delayed by 6 clock cycles.

When P/S is low, the serial control interface is disabled. When P/S is set high, Pins 22, 23, and 24 have the LE, CLK, and SER IN function.

In serial mode operation, the outputs will stay constant while LE is kept low.

Direct Parallel Mode

The parallel mode is enabled when P/S is set low. In the direct parallel mode, the phase shifter is controlled by the parallel control inputs directly. When P/S is set low, Pins 22, 23, and 24 have the D3, D2, and D1 function.

Mode Truth Table

| P/S | LE | Mode |
|-----|-----|-----------------|
| 1 | X | Serial |
| 0 | N/A | Direct Parallel |

Truth Table (Digital Phase Shifter)⁷

| D6 | D5 | D4 | D3 | D2 | D1 | Phase Shift |
|----|----|----|----|----|----|-----------------|
| 0 | 0 | 0 | 0 | 0 | 0 | Loss, Reference |
| 0 | 0 | 0 | 0 | 0 | 1 | 5.6 deg |
| 0 | 0 | 0 | 0 | 1 | 0 | 11.2 deg |
| 0 | 0 | 0 | 1 | 0 | 0 | 22.5 deg |
| 0 | 0 | 1 | 0 | 0 | 0 | 45 deg |
| 0 | 1 | 0 | 0 | 0 | 0 | 90 deg |
| 1 | 0 | 0 | 0 | 0 | 0 | 180 deg |
| 1 | 1 | 1 | 1 | 1 | 1 | 354.4 deg |

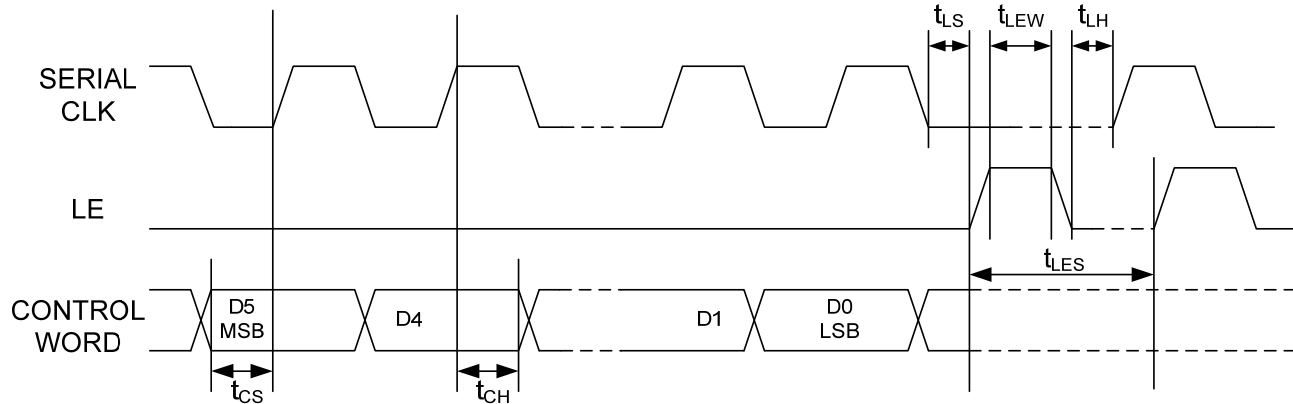
7. 0 = CMOS Low; 1 = CMOS High, X is CMOS Low or High

Serial Interface Timing Characteristics

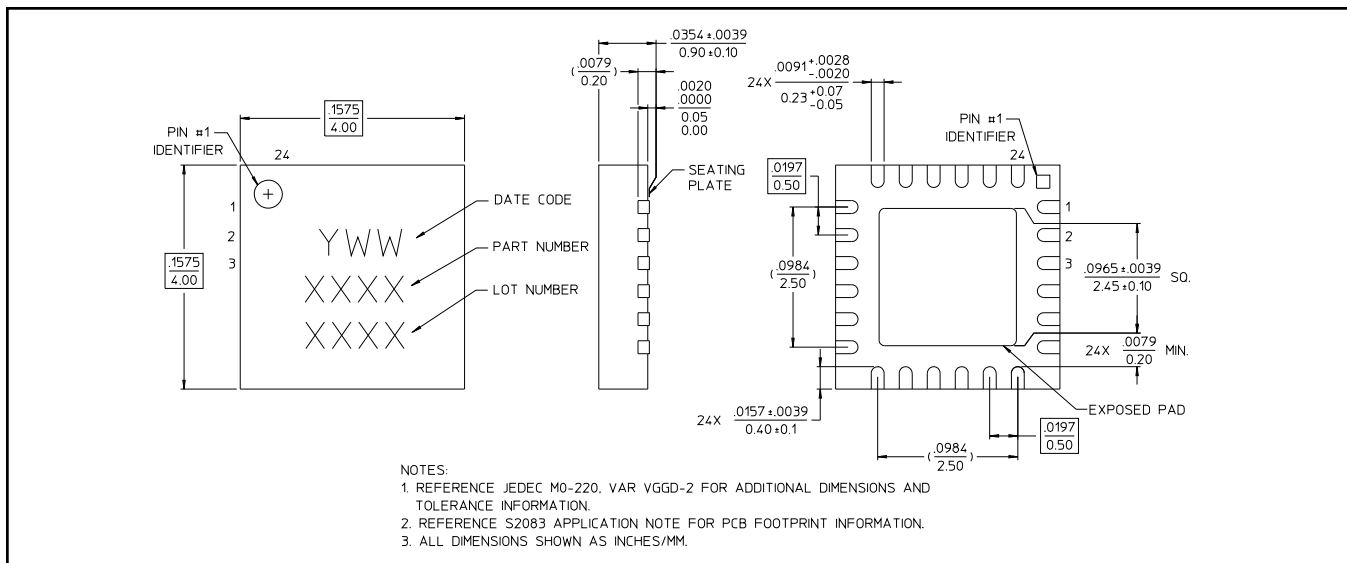
| Symbol | Parameter | Typical Performance | | | Units |
|------------------|-------------------------------------|---------------------|------|-------|-------|
| | | -40°C | 25°C | +85°C | |
| t _{SCK} | Min. Serial Clock Period | 100 | 100 | 100 | ns |
| t _{CS} | Min. Control Set-up Time | 20 | 20 | 20 | ns |
| t _{CH} | Min. Control Hold Time | 20 | 20 | 20 | ns |
| t _{LS} | Min. LE Set-up Time | 10 | 10 | 10 | ns |
| t _{LEW} | Min. LE Pulse Width | 10 | 10 | 10 | ns |
| t _{LH} | Min. Serial Clock Hold Time from LE | 10 | 10 | 10 | ns |
| t _{LES} | Min. LE Pulse Spacing | 630 | 630 | 630 | ns |

Functionality Modes of Operation: Serial and Direct Parallel

Serial Input Interface Timing Diagram



Lead Free 4 mm 24-Lead PQFN †



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.

Данный компонент на территории Российской Федерации

Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9