



## GENERAL DESCRIPTION

The M660-02 is a dual SAW, selectable frequency VCISO frequency source for low-jitter clock generation. An integrated SAW (surface acoustic wave) delay line implements the high-Q VCO (voltage controlled oscillator) function, which results in low output phase noise and very low jitter. The M660-02 is available in a range of center frequencies from 500 to 700MHz. Minimum pull-range is  $\pm 50$  ppm (wider pull-range is available). The M660-02 is well suited for phase-locked loop implementations, clock and data recovery circuits, and other timing applications in telecom and optical fiber networking systems (e.g., OC-48, OC-192).



## PIN ASSIGNMENT (9 x 14mm SMT)

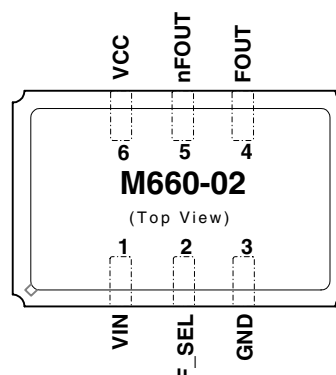


Figure 1: Pin Assignment

## FEATURES

- ◆ Two integrated SAW devices
- ◆ Selectable output frequency
- ◆ Supports multi-rate optical interface requirements
- ◆ VCISO center frequencies from 500 to 700 MHz (Specify center frequency at time of order)
- ◆ Low phase jitter 0.19ps rms typical (50kHz-80MHz)
- ◆ Low phase noise -70dBc/Hz @ 1kHz offset
- ◆ Differential 3.3V LVPECL output
- ◆ Single 3.3V power supply
- ◆ Small 9 x 14mm SMT (surface mount) package

## Sample of Available Output Frequencies

| VCISO Center Frequency <sup>1</sup> (MHz) | Applications         |
|-------------------------------------------|----------------------|
| 622.0800                                  | SONET/SDH            |
| 625.0000                                  | Gigabit Ethernet     |
| 644.5313                                  | Gigabit Ethernet FEC |
| 669.3265                                  | SONET/SDH FEC        |

Table 1: Sample of Available Output Frequencies

Note 1: Specify VCISO center frequency at time of order

## BLOCK DIAGRAM

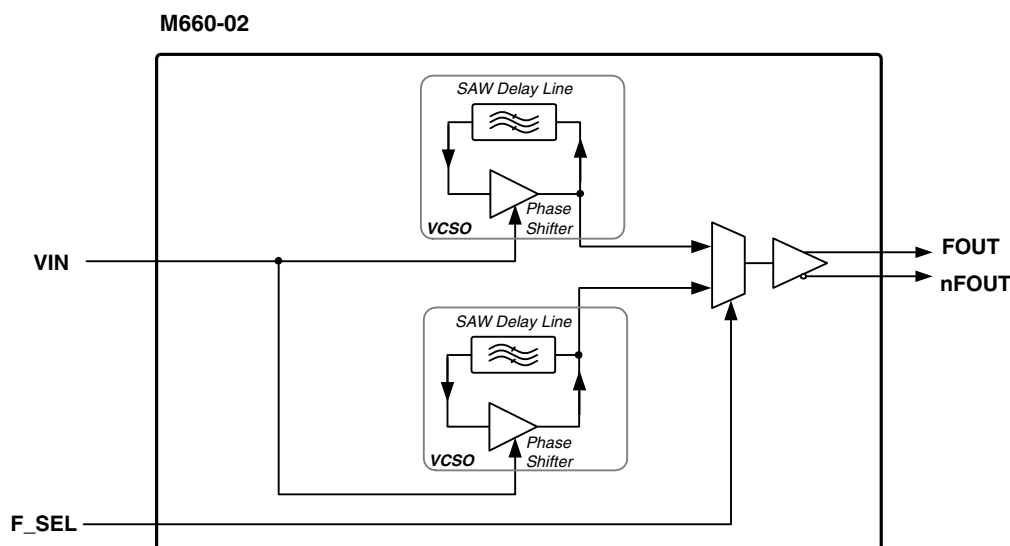


Figure 2: Block Diagram



## PIN DESCRIPTIONS

| Number | Name  | I/O    | Configuration                            | Description                                                                       |
|--------|-------|--------|------------------------------------------|-----------------------------------------------------------------------------------|
| 1      | VIN   | Input  |                                          | Tuning control voltage.                                                           |
| 2      | F_SEL | Input  | Internal pull-down resistor <sup>1</sup> | Frequency select:<br>Logic 1 selects Frequency 2.<br>Logic 0 selects Frequency 1. |
| 3      | GND   | Ground |                                          | Power supply ground connections.                                                  |
| 4      | FOUT  | Output | No internal terminator                   | Clock output pair. Differential LVPECL.                                           |
| 5      | nFOUT | Output |                                          |                                                                                   |
| 6      | VCC   | Power  |                                          | Power supply connection, connect to +3.3V.                                        |

Table 2: Pin Descriptions

Note 1: See "Frequency Select" in Table 5, [DC Characteristics](#) on pg. 3.

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

| Symbol          | Parameter            | Rating                       | Unit |
|-----------------|----------------------|------------------------------|------|
| V <sub>I</sub>  | Inputs               | -0.5 to V <sub>CC</sub> +0.5 | V    |
| V <sub>O</sub>  | Outputs              | -0.5 to V <sub>CC</sub> +0.5 | V    |
| V <sub>CC</sub> | Power Supply Voltage | 3.63                         | V    |
| T <sub>S</sub>  | Storage Temperature  | -55 to +125                  | °C   |

Table 3: Absolute Maximum Ratings

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in [Recommended Conditions of Operation](#), [DC Characteristics](#), or [AC Characteristics](#) is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

## RECOMMENDED CONDITIONS OF OPERATION

| Symbol          | Parameter                     | Min  | Typ | Max  | Unit |
|-----------------|-------------------------------|------|-----|------|------|
| V <sub>CC</sub> | Positive Supply Voltage       | 2.97 | 3.3 | 3.63 | V    |
| T <sub>A</sub>  | Ambient Operating Temperature | -40  | 25  | +85  | °C   |

Table 4: Recommended Conditions of Operation



## ELECTRICAL SPECIFICATIONS

### DC Characteristics

Unless stated otherwise,  $V_{CC} = 3.3 \text{ Volts} \pm 10\%$ ,  $T_A = 0 \text{ to } 85^\circ\text{C}$ , VCSO Frequency = 500-700MHz, Outputs terminated into  $180\Omega$  to ground

|                               | Symbol         | Parameter                     | Pin         | Min             | Typ   | Max             | Unit          |
|-------------------------------|----------------|-------------------------------|-------------|-----------------|-------|-----------------|---------------|
| Power Supply                  | $V_{CC}$       | Positive Supply Voltage       | VCC         | 2.97            | 3.3   | 3.63            | V             |
|                               | $I_{CC}$       | Power Supply Current          |             |                 | 90    | 125             | mA            |
| Control Voltage               | $V_{IN}$       | Input Control Voltage Range   | VIN         | 0               |       | $V_{CC}$        | V             |
|                               |                | $V_{IN}$ Input Impedence      |             |                 | 100   |                 | k $\Omega$    |
|                               |                | $V_{IN}$ Modulation Bandwidth |             |                 | 1000  |                 | kHz           |
| Frequency Select <sup>1</sup> | $V_{IH}$       | Input High Voltage            | F_SEL       | 2               |       | $V_{CC} + 0.3$  | V             |
|                               | $V_{IL}$       | Input Low Voltage             |             | -0.3            |       | 0.8             | V             |
|                               | $I_{IH}$       | Input High Current            |             |                 |       | 5               | $\mu\text{A}$ |
|                               | $I_{IL}$       | Input Low Current             |             | -150            |       |                 | $\mu\text{A}$ |
|                               | $R_{pulldown}$ | Internal Pull-down Resistor   |             |                 | 51    |                 | k $\Omega$    |
| Differential Outputs          | $V_{OH}$       | Output High Voltage           | FOUT, nFOUT | $V_{CC} - 0.98$ |       | $V_{CC} - 0.75$ | V             |
|                               | $V_{OL}$       | Output Low Voltage            |             | $V_{CC} - 1.95$ |       | $V_{CC} - 1.63$ | V             |
|                               | $V_{P-P}$      | Peak to Peak Output Voltage   |             | 0.475           | 0.625 | 0.85            | $V_{P-P}$     |
|                               | $I_{OUT}$      | Output Current                |             |                 |       | 20              | mA            |

Table 5: DC Characteristics

Note 1: Internally pulled down to Logic 0 (Frequency 1) if left unselected.

### AC Characteristics

Unless stated otherwise,  $V_{CC} = 3.3 \text{ Volts} \pm 10\%$ ,  $T_A = 0 \text{ to } 85^\circ\text{C}$ , VCSO Frequency = 500-700MHz, Outputs terminated into  $180\Omega$  to ground

|           | Symbol     | Parameter                                              | Min            | Typ  | Max | Unit    | Notes                                                            |
|-----------|------------|--------------------------------------------------------|----------------|------|-----|---------|------------------------------------------------------------------|
| Frequency | $F_{OUT}$  | Output Center Frequency Range                          | 500            |      | 700 | MHz     |                                                                  |
|           | APR        | Absolute Pull-Range <sup>1</sup>                       | $\pm 50$       |      |     | ppm     |                                                                  |
|           | $f_{STAB}$ | Frequency Stability                                    |                | 110  |     | ppm p-p |                                                                  |
|           | $L_{IN}$   | Tuning Linearity                                       |                | 6    |     | %       |                                                                  |
|           | $K_{VCO}$  | VCO Gain                                               | @622.08MHz     | 230  |     | ppm/V   | $V_{IN} = 0.3 \text{ to } 3.0\text{V}$<br>Best fit straight line |
| Outputs   |            | Non-harmonic Spurious                                  | -50            | -77  |     | dBc     |                                                                  |
|           | $\Phi_n$   | SSB (single sideband) Phase Noise, offset from carrier | 100Hz Offset   | -41  |     | dBc/Hz  |                                                                  |
|           |            |                                                        | 1kHz Offset    | -68  |     | dBc/Hz  |                                                                  |
|           |            |                                                        | 10kHz Offset   | -97  |     | dBc/Hz  |                                                                  |
|           |            |                                                        | 100kHz Offset  | -122 |     | dBc/Hz  |                                                                  |
|           | J(t)       | Jitter (rms)                                           | 12kHz to 20MHz | 0.37 |     | ps rms  |                                                                  |
|           |            |                                                        | 50kHz to 80MHz | 0.19 |     | ps rms  |                                                                  |
|           | odc        | Output Duty Cycle <sup>2</sup>                         | 45             |      | 55  | %       |                                                                  |
|           | $t_R$      | Output Rise Time <sup>2</sup> for FOUT, nFOUT          |                | 275  | 400 | ps      | 20% to 80%                                                       |
|           | $t_F$      | Output Fall Time <sup>2</sup> for FOUT, nFOUT          |                | 275  | 400 | ps      | 20% to 80%                                                       |

Table 6: AC Characteristics

Note 1: Consult ICS for availability of other APRs.

Note 2: See [Parameter Measurement Information](#) on pg. 4.



## PARAMETER MEASUREMENT INFORMATION

### Output Rise and Fall Time



Figure 3: Output Rise and Fall Time

### Output Duty Cycle

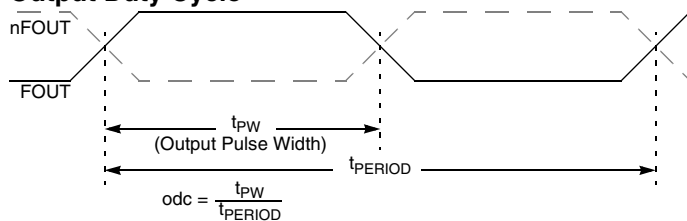
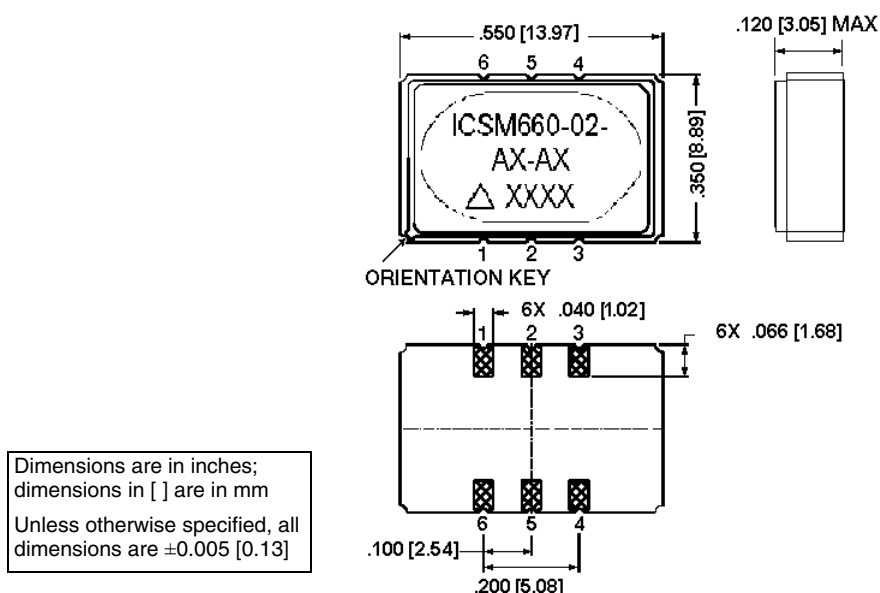


Figure 4: Output Duty Cycle

## DEVICE PACKAGE - 9 x 14mm SMT (Surface Mount) Package

### Mechanical Dimensions:



Dimensions are in inches;  
dimensions in [ ] are in mm  
Unless otherwise specified, all  
dimensions are  $\pm 0.005$  [0.13]

Figure 5: Device Package - 9 x 14mm SMT (Surface Mount) Package

## ORDERING INFORMATION

| For Output Frequencies (MHz) | Order Part Number |
|------------------------------|-------------------|
| Frequency 1, Frequency 2     | M660-02-Ax-Ax     |
| e.g., 622.0800, 669.3265     | M660-02-AA-AH     |

Table 7: Ordering Information

### Standard Output Frequencies

|    |          |    |          |
|----|----------|----|----------|
| AA | 622.0800 | AG | 669.3120 |
| AB | 625.0000 | AH | 669.3265 |
| AC | 627.3296 | AI | 670.8386 |
| AD | 644.5313 | AJ | 672.1600 |
| AE | 666.5143 | AK | 690.5692 |
| AF | 669.1281 | AL | 693.4830 |

Table 8: Standard Output Frequencies

Consult ICS for the availability of other VCSC frequencies.

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