# Frequency Synthesizer KSN-3580A+

## 50Ω 3440 to 3580 MHz

## The Big Deal

- Fractional N synthesizer
- Low phase noise and spurious
- Robust design and construction
- Small size 0.800" x 0.584" x 0.240"

CASE STYLE: DK1171

## Product Overview

The KSN-3580A+ is a Frequency Synthesizer, designed to operate from 3440 to 3580 MHz for WiMAX applications. The KSN-3580A+ is packaged in a metal case (size of 0.800" x 0.584" x 0.240") to shield against unwanted signals and noise.

## Key Features

| Feature | Advantages |
|---|---|
| Low phase noise and spurious:<br>• Phase Noise: -97 dBc/Hz typ. @ 10 kHz offset<br>• Step Size Spurious: -70 dBc typ.<br>• Comparison Spurious: -85 dBc typ.<br>• Reference Spurious: -85 dBc typ. | Low phase noise and spurious improve system EVM (Error Vector Magnitude). |
| Robust design and construction | To enhance the robustness of KSN-3580A+, each internal component is secured to the substrate with chip bonder, thereby eliminating the risk of tombstoning during subsequent solder reflow operations by the customer. |
| Small size, 0.800 " x 0.584" x 0.240" | The small size enables the KSN-3580A+ to be used in compact designs. |

*Surface Mount*

# Frequency Synthesizer

## KSN-3580A+

50Ω 3440 to 3580 MHz

### Features

- Fractional N synthesizer
- Integrated VCO + PLL
- Low phase noise and spurious
- Robust design and construction
- Low operating voltage (VCC VCO=+5V, VCC PLL=+3V)
- Small size 0.800" x 0.584" x 0.240"

CASE STYLE: DK1171
PRICE: $32.95 ea. QTY (1-9)

*+ RoHS compliant in accordance with EU Directive (2002/95/EC)*

*The +Suffix has been added in order to identify RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications.*

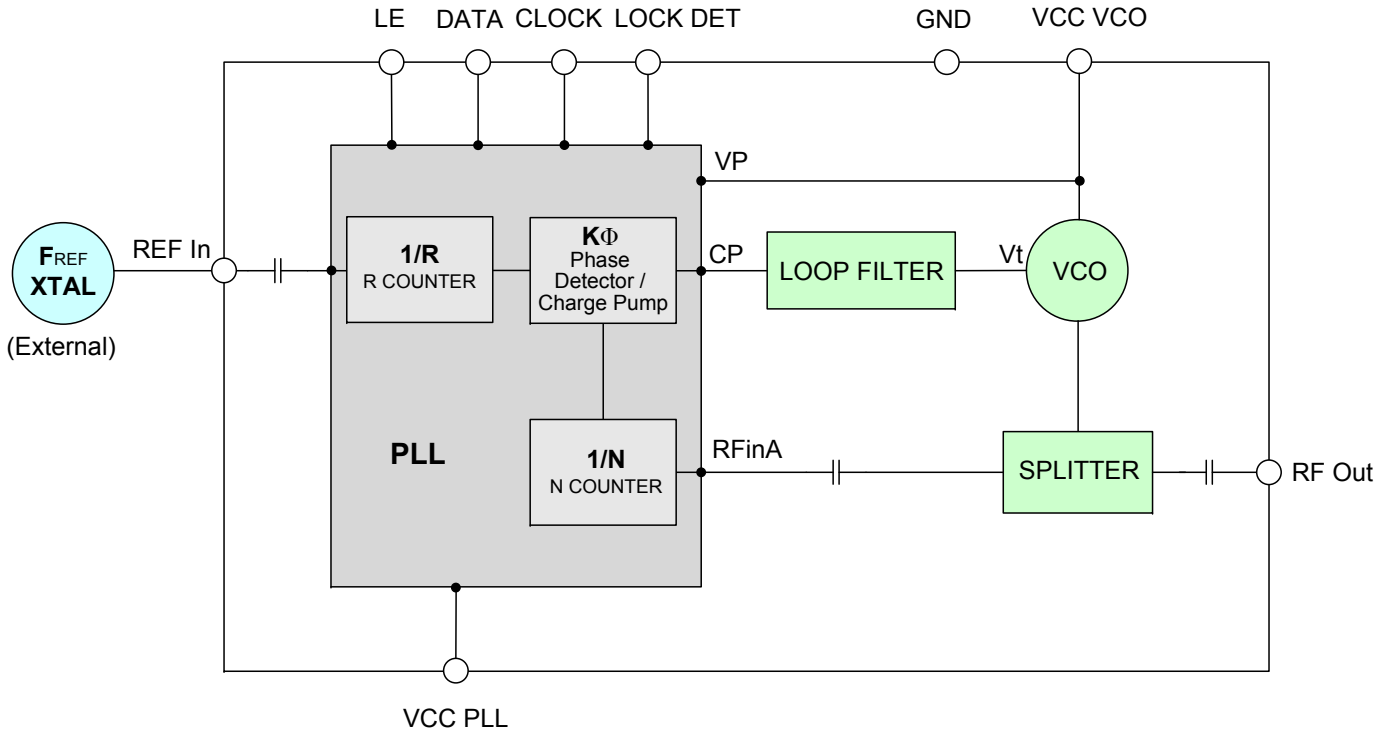
### Applications

- WiMAX

### General Description

The KSN-3580A+ is a Frequency Synthesizer, designed to operate from 3440 to 3580 MHz for WiMAX application. The KSN-3580A+ is packaged in a metal case (size of 0.800" x 0.584" x 0.240) to shield against unwanted signals and noise. To enhance the robustness of KSN-3580A+, each internal component is secured to the substrate with chip bonder, thereby eliminating the risk of tombstoning during subsequent solder reflow operations by the customer.

### Simplified Schematic



## Electrical Specifications *(over operating temperature -40°C to +85°C)*

| Parameters | | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Frequency Range | | - | 3440 | - | 3580 | MHz |
| Step Size | | - | - | 250 | - | kHz |
| Comparison Frequency | | - | - | 30 | - | MHz |
| Settling Time | | Within ± 1 kHz | - | 19 | - | mSec |
| Output Power | | - | +2.0 | +5.0 | +7.5 | dBm |
| SSB Phase Noise | | @ 100 Hz offset | - | -77 | - | dBc/Hz |
| | | @ 1 kHz offset | - | -89 | -84 | |
| | | @ 10 kHz offset | - | -97 | -92 | |
| | | @ 100 kHz offset | - | -125 | -120 | |
| | | @ 1 MHz offset | - | -146 | -141 | |
| Step Size Spurious Suppression | | Step Size 250 kHz | - | -70 | -60 | dBc |
| 0.5 Step Size Spurious Suppression | | 0.5 Step Size 125 kHz | - | -80 | -70 | |
| Reference & Comparison Spurious Suppression | | Ref. & Comp. Freq. 30 MHz | - | -85 | -75 | |
| Non - Harmonic Spurious Suppression | | - | - | -90 | - | |
| Harmonic Suppression | | - | - | -25 | -19 | |
| VCO Supply Voltage | | +5.00 | +4.75 | +5.00 | +5.25 | V |
| PLL Supply Voltage | | +3.00 | +2.85 | +3.00 | +3.15 | |
| VCO Supply Current | | - | - | 56 | 63 | mA |
| PLL Supply Current | | - | - | 17 | 25 | |
| Reference Input (External) | Frequency | 30 (square wave) | - | 30 | - | MHz |
| | Amplitude | 1 | - | 1 | - | $V_{P-P}$ |
| | Input impedance | - | - | 100 | - | KΩ |
| | Phase Noise @ 1 kHz offset | - | - | -145 | - | dBc/Hz |
| RF Output port Impedance | | - | - | 50 | - | Ω |
| Input Logic Level | Input high voltage | - | 2.55 | - | - | V |
| | Input low voltage | - | - | - | 0.55 | V |
| Analog Lock Detect | Locked | - | 2.45 | - | 3.15 | V |
| | Unlocked | - | - | - | 0.40 | V |
| Frequency Synthesizer PLL | | - | ADF4153 | | | |
| PLL Programming | | - | 3-wire serial 3V CMOS | | | |

**Register Map** NOTE 1

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R0_Register @ 3580 MHz | *Fastlock* | *9-Bit Integer Value (Int)* | | | | | *12-Bit Fractional Value (Frac)* | | | | | | | | *Control Bits* |
| | 0 | 001110111 | | | | | 000000101000 | | | | | | | | 00 |
| R1_Register | *Load Control* | *Muxout* | *Reserved* | *Prescaler* | *4-Bit R Counter* | | *12-Bit Interpolator Modulus Value (Mod)* | | | | | | | | *Control Bits* |
| | 0 | 001 | 0 | 1 | 0001 | | 000001111000 | | | | | | | | 01 |
| R2_Register | *N/A* | | | | | *Resync* | *Reference Doubler* | *CP/2* | *CP Current Setting* | *PD Polarity* | *LDP* | *Power-Down* | *CP 3-State* | *Counter Reset* | *Control Bits* |
| | 00000000 | | | | | 0000 | 0 | 0 | 011 | 1 | 1 | 0 | 0 | 0 | 10 |
| R3_Register | *N/A* | | | | | | | *Reserved* | *Noise & Spur Mode* | | *Reserved* | | | *Noise & Spur Mode* | *Control Bits* |
| | 0000000000000 | | | | | | | 0 | 1111 | | 000 | | | 1 | 11 |

**Note 1**: Registers Load Sequence: R3 Register, R2 Register, R1 Register, R0 Register.

## Absolute Maximum Ratings

| Parameters | Ratings |
|---|---|
| VCO Supply Voltage NOTE 2 | 6V |
| PLL Supply Voltage NOTE 2 | 4V |
| VCO Supply Voltage to PLL Supply Voltage NOTE 2 | -0.3V to +5.8V |
| Reference Frequency Voltage | -0.3Vmin, VCC PLL +0.3Vmax |
| Data, Clock, LE Levels | -0.3Vmin, VCC PLL +0.3Vmax |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -55°C to +100°C |

Permanent damage may occur if any of these limits are exceeded

**Note 2**: Power on/off Sequence:
Power on: VCO Supply Voltage, followed by PLL Supply Voltage.
Power off: PLL Supply Voltage, followed by VCO Supply Voltage.

## Typical Performance Data

| FREQUENCY (MHz) | POWER OUTPUT (dBm) | | | VCO CURRENT (mA) | | | PLL CURRENT (mA) | | |
|---|---|---|---|---|---|---|---|---|---|
| | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C |
| 3440 | 5.05 | 4.71 | 4.24 | 54.96 | 56.39 | 57.38 | 14.90 | 17.12 | 18.37 |
| 3446 | 5.12 | 4.78 | 4.29 | 55.01 | 56.41 | 57.40 | 14.62 | 16.83 | 18.09 |
| 3462 | 5.30 | 4.96 | 4.41 | 55.09 | 56.46 | 57.41 | 14.88 | 17.10 | 18.38 |
| 3478 | 5.46 | 5.08 | 4.52 | 55.16 | 56.49 | 57.41 | 14.45 | 16.65 | 17.93 |
| 3494 | 5.56 | 5.15 | 4.58 | 55.22 | 56.52 | 57.40 | 15.04 | 17.28 | 18.58 |
| 3510 | 5.67 | 5.23 | 4.63 | 55.24 | 56.48 | 57.40 | 12.41 | 14.58 | 15.75 |
| 3526 | 5.72 | 5.26 | 4.64 | 55.19 | 56.45 | 57.37 | 14.93 | 17.14 | 18.47 |
| 3542 | 5.76 | 5.28 | 4.66 | 55.16 | 56.40 | 57.34 | 14.43 | 16.62 | 17.93 |
| 3558 | 5.75 | 5.21 | 4.63 | 55.11 | 56.39 | 57.32 | 14.90 | 17.13 | 18.45 |
| 3574 | 5.73 | 5.23 | 4.65 | 54.96 | 56.31 | 57.31 | 14.54 | 16.75 | 18.04 |
| 3580 | 5.71 | 5.22 | 4.64 | 54.91 | 56.27 | 57.28 | 14.82 | 17.04 | 18.35 |

| FREQUENCY (MHz) | HARMONICS (dBc) | | | | | |
|---|---|---|---|---|---|---|
| | F2 | | | F3 | | |
| | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C |
| 3440 | -31.51 | -36.26 | -34.41 | -42.45 | -44.72 | -47.03 |
| 3446 | -30.32 | -35.82 | -34.13 | -43.14 | -44.53 | -47.06 |
| 3462 | -30.05 | -34.97 | -33.84 | -42.50 | -43.54 | -48.18 |
| 3478 | -28.68 | -33.72 | -33.69 | -42.22 | -44.72 | -46.62 |
| 3494 | -27.03 | -32.40 | -34.53 | -40.09 | -45.76 | -45.88 |
| 3510 | -26.55 | -32.34 | -34.10 | -40.70 | -42.93 | -45.96 |
| 3526 | -27.47 | -33.52 | -33.86 | -42.18 | -43.64 | -48.59 |
| 3542 | -26.54 | -33.36 | -35.84 | -46.34 | -45.23 | -49.85 |
| 3558 | -26.36 | -35.28 | -36.40 | -41.85 | -50.23 | -47.27 |
| 3574 | -30.29 | -36.96 | -38.82 | -40.44 | -48.83 | -49.49 |
| 3580 | -30.56 | -38.24 | -38.87 | -40.08 | -47.99 | -48.40 |

| FREQUENCY (MHz) | PHASE NOISE (dBc/Hz) @OFFSETS +25°C | | | | |
|---|---|---|---|---|---|
| | 100Hz | 1kHz | 10kHz | 100kHz | 1MHz |
| 3440 | -79.21 | -88.35 | -96.09 | -124.60 | -145.24 |
| 3446 | -78.52 | -88.97 | -96.88 | -124.60 | -145.51 |
| 3462 | -76.34 | -90.47 | -97.38 | -125.04 | -145.84 |
| 3478 | -77.70 | -91.05 | -98.17 | -125.29 | -146.36 |
| 3494 | -78.11 | -88.56 | -97.61 | -125.83 | -146.38 |
| 3510 | -77.36 | -89.12 | -98.63 | -125.69 | -146.44 |
| 3526 | -79.61 | -90.53 | -97.55 | -125.53 | -146.84 |
| 3542 | -78.61 | -91.53 | -97.32 | -126.00 | -146.56 |
| 3558 | -77.08 | -90.13 | -98.32 | -125.78 | -146.55 |
| 3574 | -78.32 | -90.69 | -97.88 | -125.85 | -146.74 |
| 3580 | -75.40 | -90.10 | -97.81 | -125.50 | -147.09 |

| FREQUENCY (MHz) | PHASE NOISE (dBc/Hz) @OFFSETS -45°C | | | | |
|---|---|---|---|---|---|
| | 100Hz | 1kHz | 10kHz | 100kHz | 1MHz |
| 3440 | -76.10 | -89.71 | -94.91 | -123.28 | -144.71 |
| 3446 | -76.82 | -92.45 | -95.50 | -123.50 | -144.74 |
| 3462 | -78.06 | -90.09 | -95.95 | -123.95 | -145.28 |
| 3478 | -76.67 | -90.60 | -96.64 | -124.49 | -145.99 |
| 3494 | -81.24 | -89.87 | -96.63 | -125.01 | -146.55 |
| 3510 | -77.51 | -90.81 | -96.79 | -125.27 | -146.57 |
| 3526 | -75.29 | -89.62 | -97.01 | -125.23 | -145.76 |
| 3542 | -78.52 | -89.99 | -97.65 | -125.59 | -147.71 |
| 3558 | -77.33 | -89.10 | -97.39 | -125.98 | -147.45 |
| 3574 | -78.03 | -91.89 | -96.83 | -125.54 | -147.13 |
| 3580 | -77.61 | -91.48 | -96.96 | -125.17 | -146.89 |

| FREQUENCY (MHz) | PHASE NOISE (dBc/Hz) @OFFSETS +85°C | | | | |
|---|---|---|---|---|---|
| | 100Hz | 1kHz | 10kHz | 100kHz | 1MHz |
| 3440 | -79.88 | -90.29 | -97.52 | -124.93 | -145.51 |
| 3446 | -78.33 | -90.65 | -98.18 | -125.07 | -145.69 |
| 3462 | -77.13 | -90.61 | -98.09 | -125.49 | -146.17 |
| 3478 | -80.54 | -91.13 | -98.42 | -125.22 | -146.33 |
| 3494 | -77.75 | -90.18 | -98.47 | -125.53 | -146.98 |
| 3510 | -78.62 | -91.95 | -98.33 | -125.94 | -146.82 |
| 3526 | -77.13 | -88.55 | -98.68 | -125.56 | -146.54 |
| 3542 | -76.00 | -89.43 | -98.06 | -125.43 | -146.77 |
| 3558 | -77.16 | -89.97 | -98.47 | -125.55 | -146.19 |
| 3574 | -76.15 | -89.82 | -98.20 | -125.65 | -146.70 |
| 3580 | -78.61 | -91.82 | -98.13 | -125.57 | -146.24 |

| REFERENCE & COMPARISON SPURIOUS ORDER | REFERENCE & COMPARISON SPURIOUS @Fcarrier 3440MHz+(n*Freference) (dBc) note 1 | | | REFERENCE & COMPARISON SPURIOUS @Fcarrier 3512MHz+(n*Freference) (dBc) note 1 | | | REFERENCE & COMPARISON SPURIOUS @Fcarrier 3580MHz+(n*Freference) (dBc) note 1 | | |
|---|---|---|---|---|---|---|---|---|---|
| n | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C |
| -5 | -100.51 | -107.55 | -105.95 | -102.80 | -105.92 | -103.67 | -103.78 | -99.91 | -102.85 |
| -4 | -101.62 | -107.42 | -102.13 | -99.29 | -99.41 | -102.56 | -98.36 | -97.79 | -100.49 |
| -3 | -109.52 | -115.91 | -106.46 | -102.22 | -105.18 | -105.53 | -106.61 | -108.48 | -110.77 |
| -2 | -104.40 | -100.72 | -99.13 | -93.75 | -95.55 | -97.81 | -96.85 | -96.56 | -95.84 |
| -1 | -97.27 | -96.84 | -97.21 | -101.92 | -96.38 | -100.10 | -91.10 | -93.88 | -90.82 |
| 0 note 2 | - | - | - | - | - | - | - | - | - |
| +1 | -100.96 | -98.65 | -96.18 | -93.05 | -98.63 | -90.65 | -92.22 | -93.14 | -88.92 |
| +2 | -100.63 | -105.41 | -104.23 | -102.78 | -106.17 | -112.05 | -96.09 | -95.99 | -96.32 |
| +3 | -97.11 | -100.72 | -100.84 | -96.71 | -101.12 | -104.76 | -105.23 | -106.04 | -110.56 |
| +4 | -105.89 | -102.39 | -106.76 | -105.99 | -102.73 | -109.21 | -99.10 | -95.71 | -97.21 |
| +5 | -99.63 | -107.36 | -99.56 | -97.23 | -102.71 | -96.08 | -99.46 | -101.75 | -96.25 |

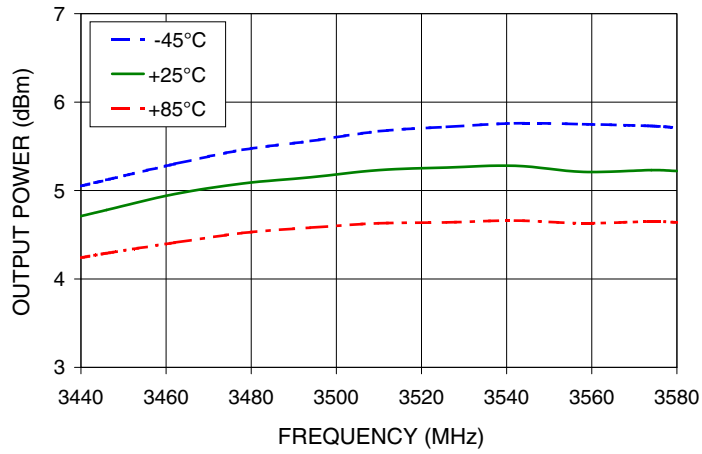
Note 1: Reference frequency = Comparison frequency = 30 MHz
Note 2: All spurs are referenced to carrier signal (n=0).

| STEP SIZE SPURIOUS ORDER | 0.5 STEP SIZE & STEP SIZE SPURIOUS @Fcarrier 3440MHz+(n*Fstep size) (dBc) note 3 | | | 0.5 STEP SIZE & STEP SIZE SPURIOUS @Fcarrier 3512MHz+(n*Fstep size) (dBc) note 3 | | | 0.5 STEP SIZE & STEP SIZE SPURIOUS @Fcarrier 3580MHz+(n*Fstep size) (dBc) note 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| n | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C | -45°C | +25°C | +85°C |
| -5.0 | -109.85 | -116.06 | -119.09 | -118.55 | -115.44 | -116.70 | -111.03 | -110.07 | -113.05 |
| -4.5 | -116.78 | -116.53 | -120.11 | -118.38 | -119.51 | -118.62 | -120.61 | -118.34 | -118.54 |
| -4.0 | -115.57 | -115.04 | -118.75 | -118.35 | -117.36 | -118.46 | -113.22 | -117.20 | -118.05 |
| -3.5 | -114.81 | -116.00 | -117.15 | -117.50 | -112.33 | -114.42 | -115.24 | -115.63 | -118.75 |
| -3.0 | -112.74 | -114.03 | -117.22 | -114.03 | -112.71 | -112.83 | -108.12 | -110.61 | -107.54 |
| -2.5 | -111.70 | -113.37 | -115.03 | -116.77 | -108.87 | -113.97 | -114.65 | -114.30 | -116.24 |
| -2.0 | -105.24 | -108.07 | -106.87 | -108.24 | -111.26 | -111.39 | -109.57 | -105.39 | -104.98 |
| -1.5 | -105.81 | -108.05 | -102.82 | -104.75 | -103.73 | -106.58 | -105.30 | -105.47 | -104.63 |
| -1.0 | -89.48 | -101.83 | -97.95 | -98.89 | -99.25 | -101.30 | -85.30 | -92.06 | -90.17 |
| -0.5 | -91.11 | -89.13 | -89.08 | -88.83 | -88.93 | -89.92 | -86.59 | -88.44 | -89.94 |
| 0 note 4 | - | - | - | - | - | - | - | - | - |
| +0.5 | -89.58 | -90.31 | -89.43 | -89.36 | -89.22 | -91.54 | -88.64 | -90.55 | -90.16 |
| +1.0 | -89.52 | -100.16 | -96.15 | -102.15 | -100.13 | -101.14 | -85.78 | -92.06 | -92.57 |
| +1.5 | -106.30 | -108.49 | -103.15 | -107.23 | -108.12 | -104.11 | -108.91 | -103.83 | -107.75 |
| +2.0 | -107.87 | -108.29 | -105.43 | -109.08 | -109.79 | -112.01 | -111.32 | -105.07 | -105.75 |
| +2.5 | -115.06 | -112.97 | -112.15 | -114.45 | -113.13 | -116.25 | -113.34 | -112.08 | -113.51 |
| +3.0 | -115.13 | -114.11 | -116.41 | -114.57 | -117.97 | -116.56 | -112.64 | -111.56 | -116.44 |
| +3.5 | -113.71 | -115.36 | -116.70 | -118.59 | -116.86 | -117.32 | -115.71 | -116.37 | -117.28 |
| +4.0 | -120.02 | -114.97 | -118.83 | -120.24 | -117.21 | -118.60 | -113.10 | -116.11 | -117.08 |
| +4.5 | -118.32 | -115.55 | -117.96 | -117.49 | -121.19 | -114.58 | -118.00 | -116.18 | -119.96 |
| +5.0 | -113.51 | -111.28 | -119.67 | -115.80 | -118.45 | -115.54 | -110.27 | -111.14 | -106.01 |

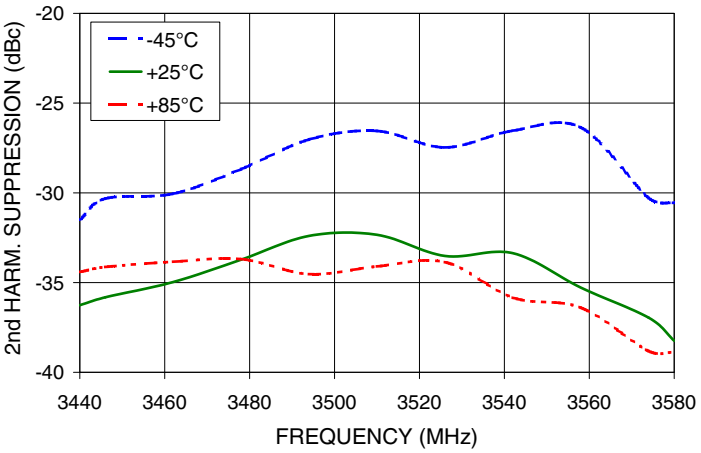
Note 3: Step size 250 KHz
Note 4: All spurs are referenced to carrier signal (n=0).

## Typical Performance Curves

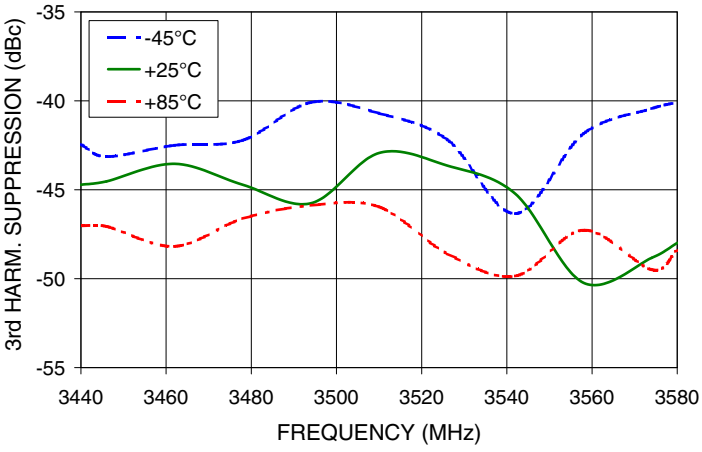
OUTPUT POWER Vs FREQUENCY



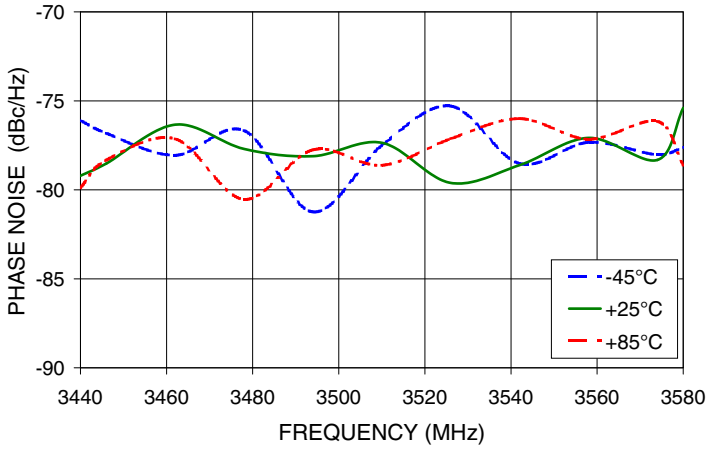

2nd HARMONIC Vs FREQUENCY



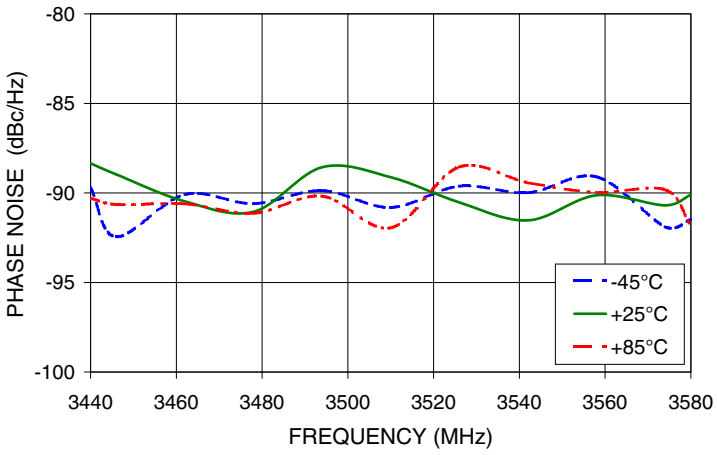

3rd HARMONIC Vs FREQUENCY



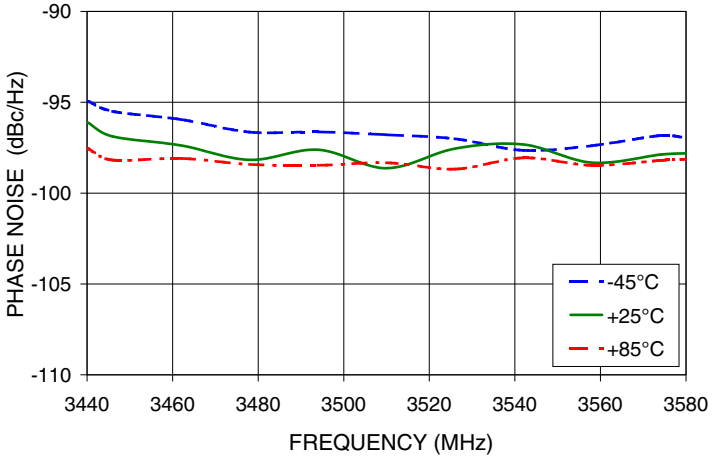
PHASE NOISE @100Hz offset



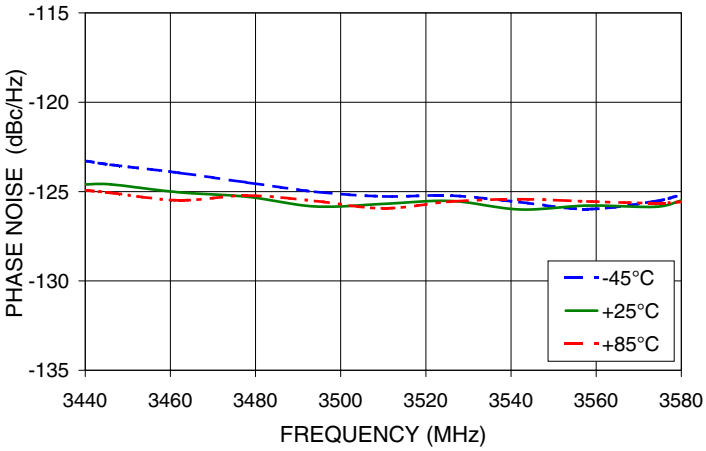

PHASE NOISE @1kHz offset



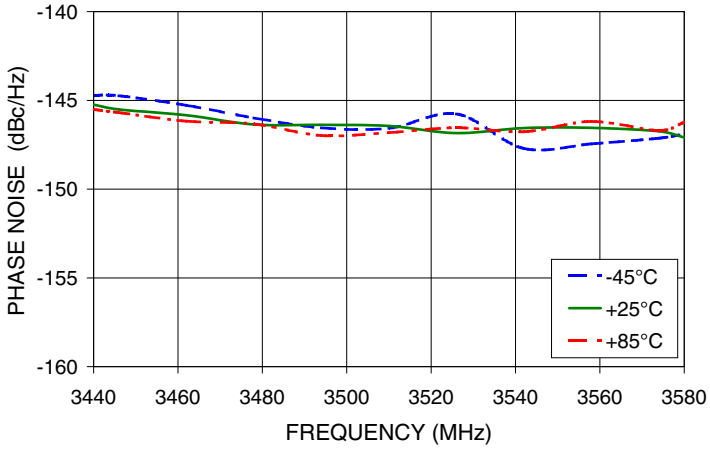

PHASE NOISE @10kHz offset



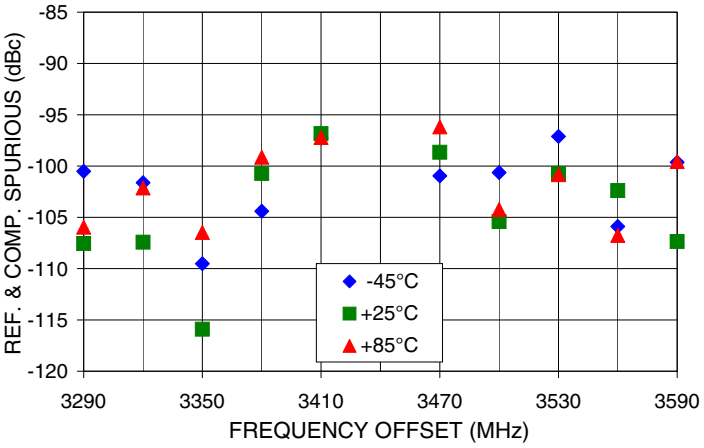

PHASE NOISE @100kHz offset



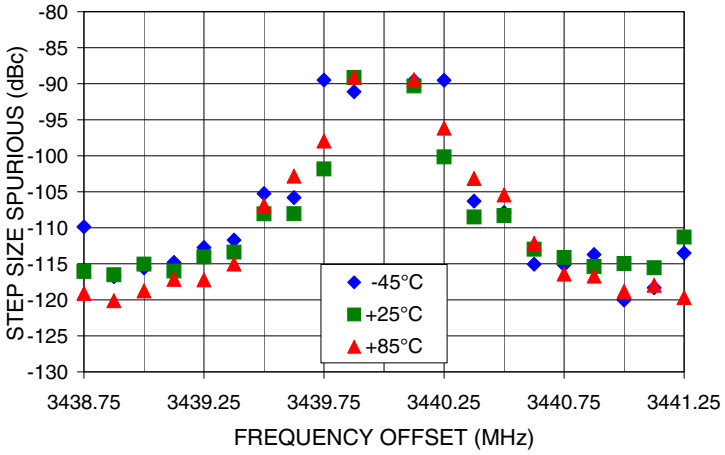

PHASE NOISE @1MHz offset



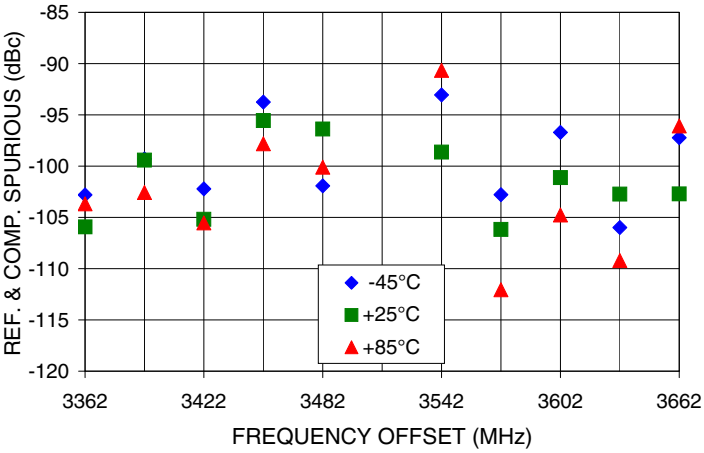
REFERENCE & COMPARISON SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3440MHz



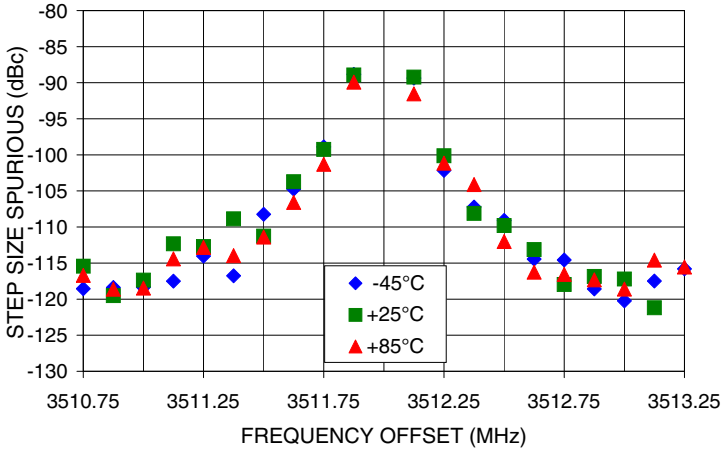

0.5 STEP SIZE & STEP SIZE SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3440MHz



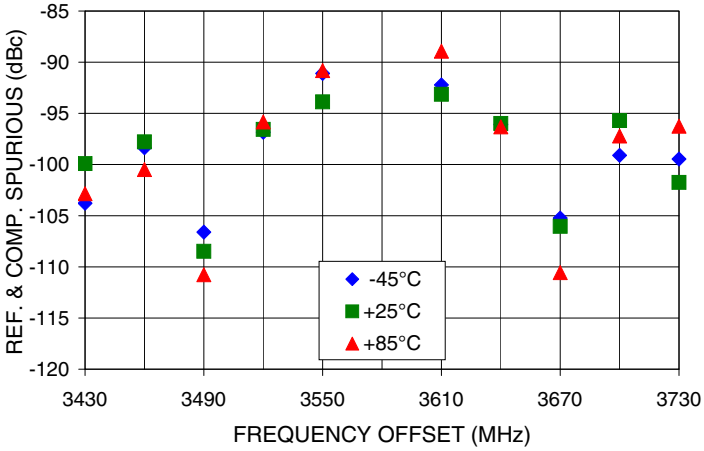

REFERENCE & COMPARISON SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3512MHz



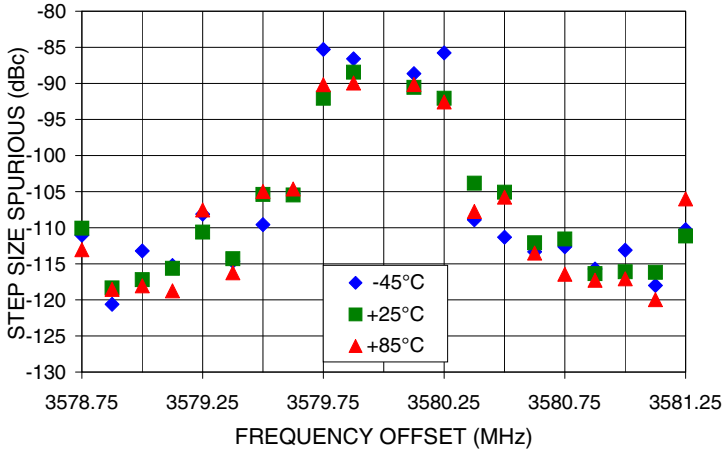

0.5 STEP SIZE & STEP SIZE SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3512MHz



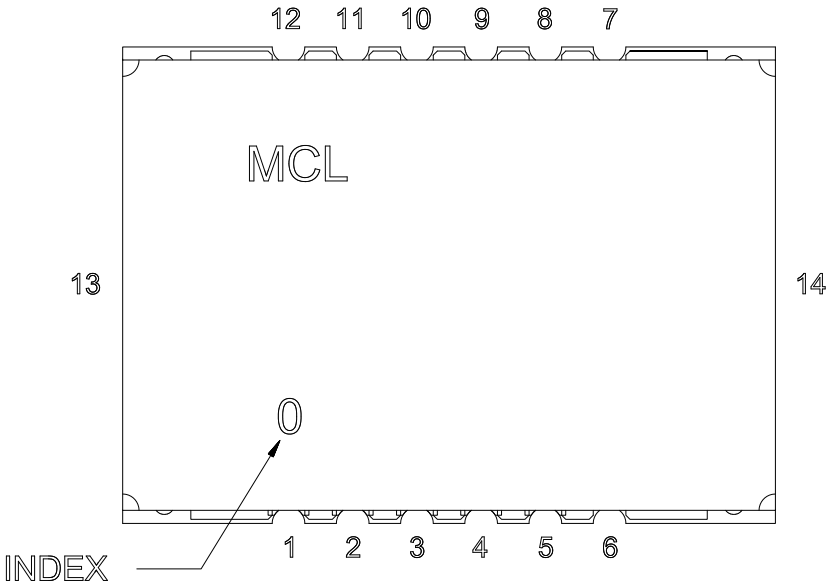

REFERENCE & COMPARISON SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3580MHz




0.5 STEP SIZE & STEP SIZE SPURIOUS
Vs FREQ. OFFSET @ Fcar = 3580MHz



## Pin Configuration

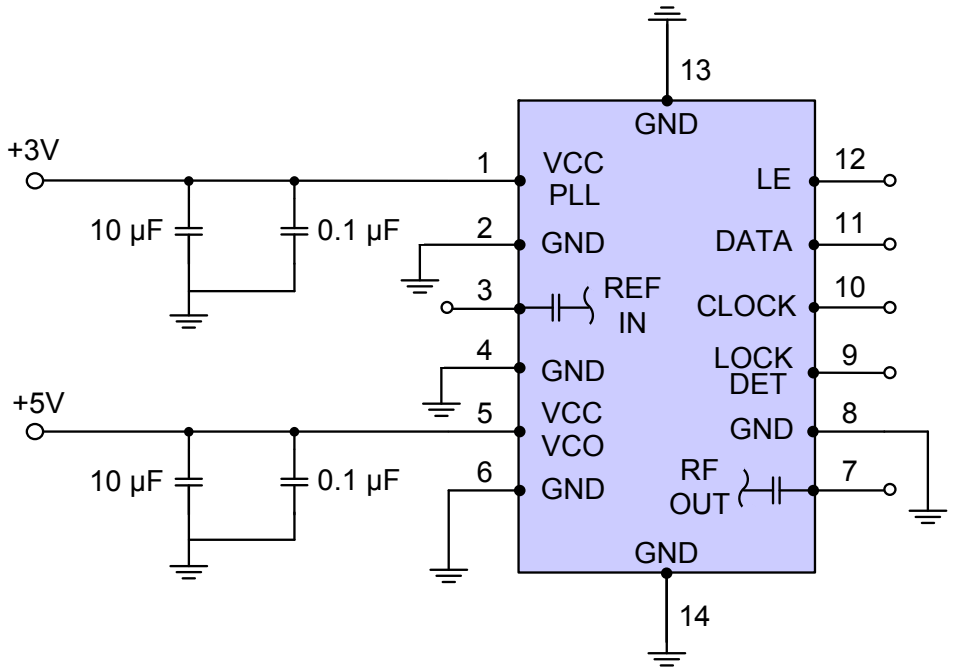



## Pin Connection

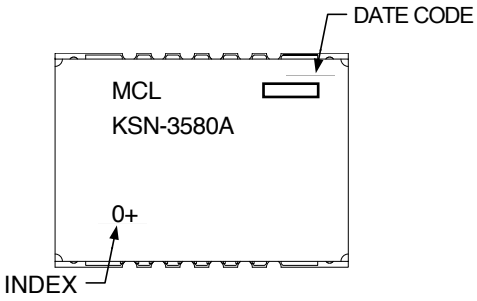
| Pin Number | Function |
|---|---|
| 1 | VCC PLL |
| 2 | GND |
| 3 | REF IN |
| 4 | GND |
| 5 | VCC VCO |
| 6 | GND |
| 7 | RF OUT |
| 8 | GND |
| 9 | LOCK DET |
| 10 | CLOCK |
| 11 | DATA |
| 12 | LE |
| 13 | GND |
| 14 | GND |

## Recommended Application Circuit

Note: REF IN and RF OUT ports are internally AC coupled.



## Device Marking




## Additional Detailed Technical Information

Additional information is available on our web site. To access this information enter the model number on our web site home page.

**Case Style:** DK1171

**Tape & Reel:** TR-F28

**Suggested Layout for PCB Design:** PL-249

**Evaluation Board:** TB-567-2+

**Environment Ratings:** ENV03T2