

PRELIMINARY DATA SHEET

SKY73083-21: 1700 – 2200 MHz High Gain and Linearity Diversity Downconversion Mixer

Applications

- 2G/3G base station transceivers:
 - GSM/EDGE, CDMA, UMTS/WCDMA
- Land mobile radio
- High performance radio links

Features

- Operating frequency range: 1700 to 2200 MHz
- Specifically optimized for the 1800 MHz band (1710 to 1785 MHz)
- IF frequency range: 50 to 500 MHz
- Conversion gain: 9 dB
- Input IP3: +26 dBm
- Output IP3: +35 dBm
- Noise Figure: 8.9 dB
- Power-down mode
- Integrated LO drivers
- Integrated low loss RF baluns
- High linearity IF amplifiers
- On-chip SPDT LO switch (greater than 40 dB LO-to-LO isolation)
- Small, MCM (36-pin, 6 x 6 mm) package (MSL3, 260 °C per JEDEC J-STD-020)

NEW



Skyworks Green™ products are RoHS (Restriction of Hazardous Substances)-compliant, conform to the EIA/EICTA/JEITA Joint Industry Guide (JIG) Level A guidelines, are halogen free according to IEC-61249-2-21, and contain <1,000 ppm antimony trioxide in polymeric materials.

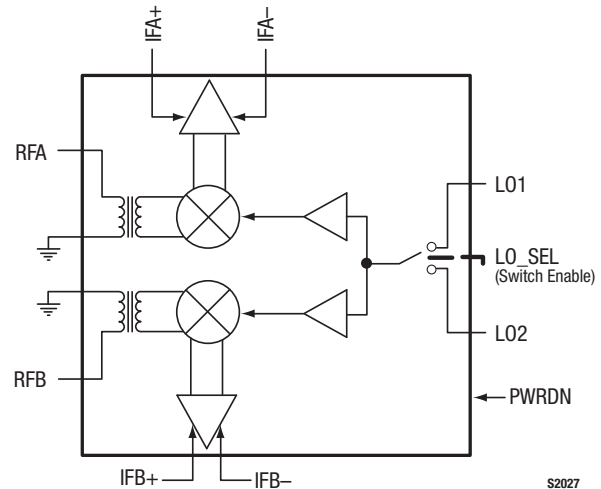


Figure 1. SKY73083-21 Block Diagram

Description

The SKY73083-21 is a fully integrated diversity mixer that includes Local Oscillator (LO) drivers, an LO switch, high linearity mixers, and large dynamic range Intermediate Frequency (IF) amplifiers. Low loss RF baluns have also been included to reduce design complications and lower system cost.

The SKY73083-21 operates in a wide RF input frequency range of 1700 to 2200 MHz but the device is optimized for the best performance in the 1710 to 1785 MHz frequency range.

The SKY73083-21 features an input IP3 of +26 dBm and a Noise Figure (NF) of 8.9 dB, making the device an ideal solution for high dynamic range systems such as 2G/3G base station receivers. The LO switch provides more than 40 dB of isolation between LO inputs and supports the switching time required for GSM/EDGE base stations.

The SKY73083-21 is manufactured using a robust silicon BiCMOS process and has been designed for optimum long-term reliability. The SKY73083-21 diversity downconversion mixer is provided in a compact, 36-pin Multi-Chip Module (MCM). A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

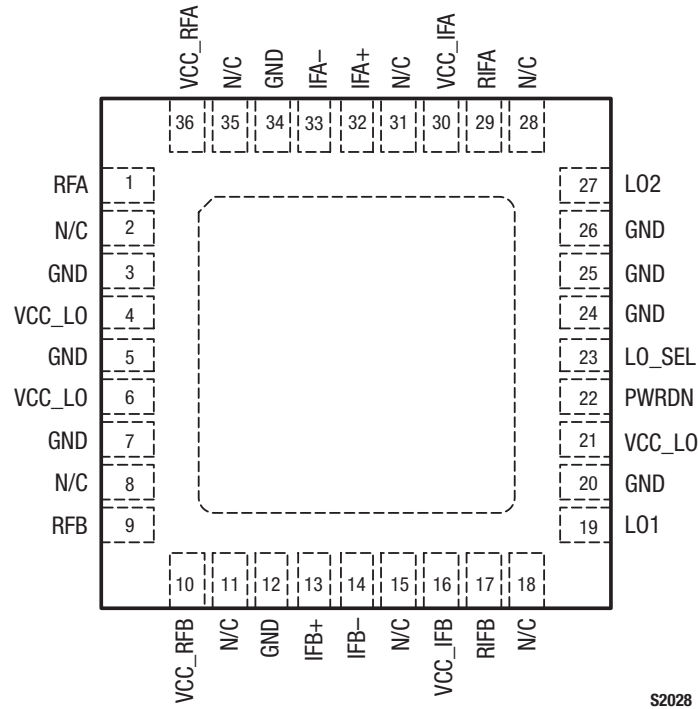


Figure 2. SKY73083-21 Pinout – 36-Pin MCM (Top View)

Table 1. SKY73083-21 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	RFA	RF channel A input	19	LO1	Local oscillator #1 input
2	N/C	No connect	20	GND	Ground
3	GND	Ground	21	VCC5	DC supply, +5 V
4	VCC1	DC supply, +5 V	22	PWRDN	Power-down mode enable
5	GND	Ground	23	LO_SEL	Local oscillator switch select
6	VCC2	DC supply, +5 V	24	GND	Ground
7	GND	Ground	25	GND	Ground
8	N/C	No connect	26	GND	Ground
9	RFB	RF channel B input	27	LO2	Local oscillator #2 input
10	VCC3	DC supply, +5 V	28	N/C	No connect
11	N/C	No connect	29	RIFA	IF channel A bias control
12	GND	Ground	30	VCC6	DC supply, +5 V
13	IFB+	IF channel B positive output	31	N/C	No connect
14	IFB-	IF channel B negative output	32	IFA+	IF channel A positive output
15	N/C	No connect	33	IFA-	IF channel A negative output
16	VCC4	DC supply, +5 V	34	GND	Ground
17	RIFB	IF channel B bias control	35	N/C	No connect
18	N/C	No connect	36	VCC7	DC supply, +5 V

Functional Description

The SKY73083-21 is a high gain diversity mixer, optimized for base station receiver applications. The device consists of two diversity channels, each consisting of a low loss RF balun, high linearity passive mixer, and a low noise IF amplifier.

The SKY73083-21 also includes a power-down feature used to lower the supply current for standby operation.

LO amplifiers are also included that allow the SKY73083-21 to connect directly to the output of a Voltage Controlled Oscillator (VCO). This eliminates the extra gain stages needed by most discrete passive mixers. A Single Pole, Double Throw (SPDT) switch has been included to select between two different LO inputs for frequency hopping applications (i.e., GSM).

RF Baluns and Passive Mixer

The RF baluns provide a single ended input, which can easily be matched to $50\ \Omega$ using a simple matching circuit. The RF baluns offer very low loss and excellent amplitude and phase balance.

The high linearity mixer is a passive, double balanced mixer that provides a very low insertion loss, and excellent 3rd Order Input Insertion Point (IIP3) and linearity performance.

Additionally, the balanced nature of the mixer provides for excellent port-to-port isolation.

LO Buffers and SPDT LO Switch

The LO buffers allow the input power of the SKY73083-21 to be programmed in the range of -6 to $+6$ dBm. The LO section has been optimized for high-side LO injection. However, the LO can be driven over a wide frequency range with only slight degradation in performance.

A high isolation SPDT switch allows the SKY73083-21 to be used for frequency hopping applications. This switch provides greater than 60 dB of LO1 to LO2 isolation:

LO_SEL Logic:

High

Low

State:

LO1 enabled

LO2 enabled

For applications that do not require frequency hopping, LO_SEL is fixed to one state and the appropriate LO input is used.

Power-Down Mode

The SKY73083-21 also includes a low current power-down mode controlled by pin 22 (PWRDN). When this pin is at a logic high level, the power-down function is enabled with the total mixer current under $1\ \mu\text{A}$.

IF Amplifier

The SKY73083-21 includes high dynamic range IF amplifiers that follow the passive mixers in the signal path. The outputs require a supply voltage connection using inductive chokes. These choke inductors should be high-Q and have the ability to handle 200 mA or greater.

A simple matching network allows the output ports to be matched to a balanced $200\ \Omega$ impedance. The IF amplifiers are optimized for IF frequencies between 50 and 500 MHz. The IF amplifiers can be operated outside of this range, but with a slight degradation in performance.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY73083-21 are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4. Spurious suppression measurements are listed in Table 5.

Table 2. SKY73083-21 Absolute Maximum Ratings

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage, +5 V (VCC1 – VCC7)	VCC	4.5	5.0	5.5	V
Supply current	I _{CC}		370	420	mA
RF input power	P _{RF}			+20	dBm
LO input power	P _{LO}		0	+20	dBm
Operating case temperature	T _C	–40		+85	°C
Junction temperature	T _J			+150	°C
Storage case temperature	T _{STG}	–40		+125	°C

Notes: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

Nominal thermal resistance (junction to center ground pad) is 5.1 °C/W.

CAUTION: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

Table 3. SKY73083-21 Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Units
Supply voltage, +5 V (VCC1 – VCC7)	VCC	4.75	5.00	5.25	V
Supply current	I _{CC}		370		mA
RF frequency range	F _{RF}	1700		2200	MHz
LO frequency range (Note 1)	F _{LO}	1800		2550	MHz
IF frequency range	F _{IF}	50		500	MHz
LO input power	P _{LO}	–6	0	+6	dBm
LO select logic: high	LO_SELH	2.2			V
low	LO_SELL			0.8	V
Operating case temperature	T _C	–40		+85	°C

Note 1: The SKY73083-21 has been optimized for high-side LO injection. However, the LO can be used outside of the specified frequency range with degraded performance.

Table 4. SKY73083-21 Electrical Specifications (Note 1)**(Voltage Supply = +5 V, T_c = +25 °C, L₀ = 0 dBm, RF Frequency = 1750 MHz, IF Frequency = 350 MHz, LO Frequency = 2100 MHz, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition	Min	Typical	Max	Units
Conversion gain	G		8.1	9.0		dB
Gain variation over temperature	G			±0.8		dB
Noise Figure	NF			8.9	11.0	dB
Noise Figure variation over temperature	NF			±1.0		dB
Noise Figure with a blocker signal	NF _{BLK}	Blocking signal input power = +8 dBm		18	25	dB
3 rd Order Input Intercept Point	IIP3	Tone space = 800 kHz, input tone power = -10 dBm	+23.5	+26.0		dBm
3 rd Order Input Intercept Point variation over temperature	IIP3			±0.6		dB
3 rd Order Output Intercept Point	OIP3	Tone space = 800 kHz, input tone power = -10 dBm		+34		dBm
2RF – 2LO	2x2	P _{RF} = -10 dBm	-60	-68		dBc
3RF – 3LO	3x3	P _{RF} = -10 dBm	-70	-80		dBc
Input 1 dB compression point	IP1dB		+11.8	+13.6		dBm
Output 1 dB compression point	OP1dB			+21.6		dBm
LO1 to LO2 isolation				40		dB
Channel-to-channel isolation			40	46		dB
RF to IF isolation			39	64		dB
LO leakage: 1XLO @ RF port 2XLO @ RF port 3XLO @ RF port 4XLO @ RF port @ IF port			-25 -25 -60 -50 -35	-30 -27 -78 -80 -46		dBm dBm dBm dBm dBm
Logic input current			-20	+150	+250	μA
Power-down current	I _{OFF}	PWRDN = 1			2	μA
Power-down/up time					1	μs
LO switching time					1.0	μs
RF port input return loss	Z _{IN_RF}	With external matching components	14			dB
LO port input return loss	Z _{IN_LO}	With external matching components	14			dB
IF port input return loss	Z _{OUT_IF}	With external matching components	14			dB

Note 1: Performance is guaranteed only under the conditions listed in this Table.

Table 5. SKY73083-21 Spur Suppression Measurements, 3GPP Band #3 (Note 1)

Parameter	Symbol	Test Condition	Maximum (dBc)	Typical (dBc)
4RF-3LO	4X3	PRF = -3	-95	-102
5RF-4LO	5X4	PRF = +3	-95	-102
6RF-5LO	6X5	PRF = +5, FRF = 1790 MHz, IF spur = 240 MHz	-95	-107
6RF-5LO	6X5	PRF = +5, FRF = 1705 MHz, IF spur = 270 MHz	-95	-108
7RF-6LO	7X6	PRF = +5	-95	-118
8RF-7LO	8X7	PRF = +5	-95	-115
9RF-7LO	9X7	PRF = +5	-95	-123
9RF-8LO	9X8	PRF = +5	-95	-112
10RF-8LO	10X8	PRF = +5	-95	-125

Note 1: Performance is guaranteed only under the conditions listed in this Table.

Evaluation Board Description

The SKY73083-21 Evaluation Board is used to test the performance of the SKY73083-21 downconversion mixer. An assembly drawing for the Evaluation Board is shown in Figure 3 and the layer detail is provided in Figure 4. A schematic diagram of the SKY73083-21 Evaluation Board is shown in Figure 5.

Circuit Design Configurations

The following design considerations are general in nature and must be followed regardless of final use or configuration:

1. Paths to ground should be made as short as possible.
2. The ground pad of the SKY73083-21 has special electrical and thermal grounding requirements. This pad is the main thermal conduit for heat dissipation. Since the circuit board acts as the heat sink, it must shunt as much heat as possible from the device. Therefore, design the connection to the ground pad to dissipate the maximum wattage produced by the circuit board.
3. Skyworks recommends including external bypass capacitors on the VCC voltage inputs of the device.
4. Components L5, L6, L14, and L15 (see Figure 5) are high-Q low loss inductors. These inductors must be able to pass currents in excess of 200 mA DC.
5. Components R1 and R2 (see Figure 5) set the bias current for the IF amplifiers. Skyworks recommends that these resistors have a tolerance of $\pm 1\%$ to optimize performance consistency of the SKY73083-21. These resistors are not required for the Evaluation Board to operate as specified in Tables 3 and 4.

Package Dimensions

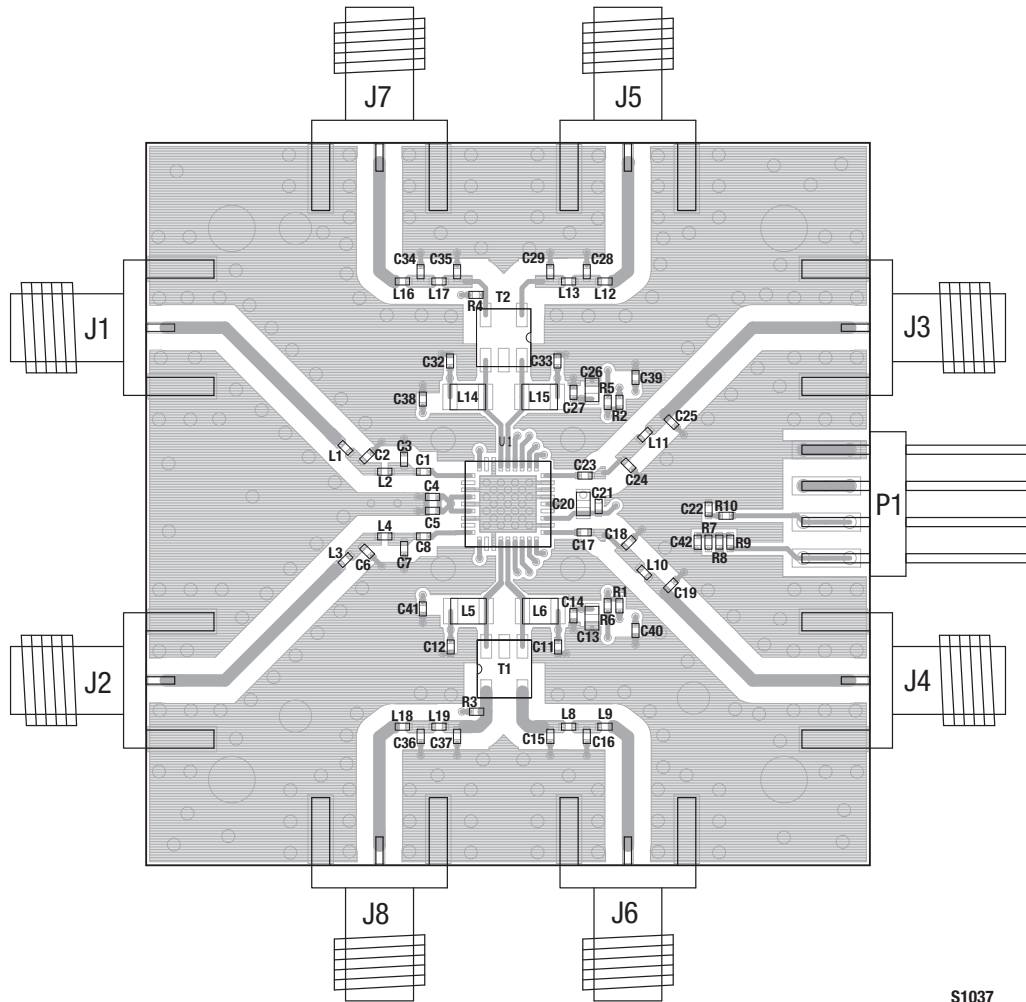
The PCB layout footprint for the SKY73083-21 is provided in Figure 6. Figure 7 shows the package dimensions for the 36-pin MCM and Figure 8 provides the tape and reel dimensions.

Package and Handling Information

Since the device package is sensitive to moisture absorption, it is baked and vacuum packed before shipping. Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

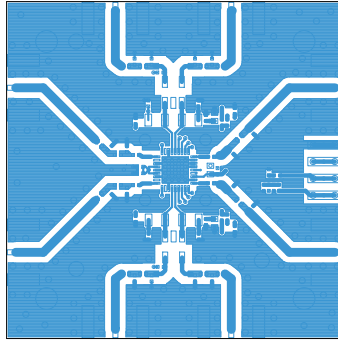
THE SKY73083-21 is rated to Moisture Sensitivity Level 3 (MSL3) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design & SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



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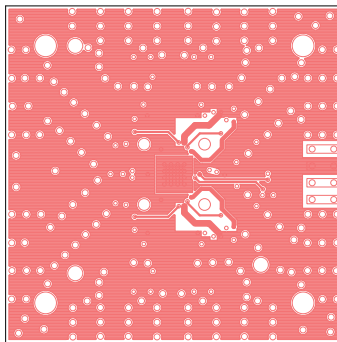
Figure 3. SKY73083-21 Evaluation Board Assembly Diagram



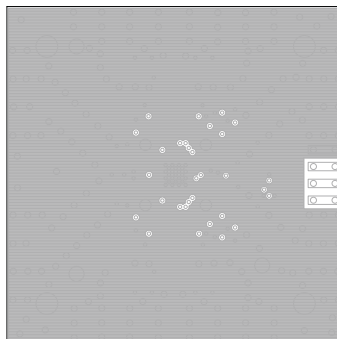
Layer 1: Top – Metal



Layer 2: Ground



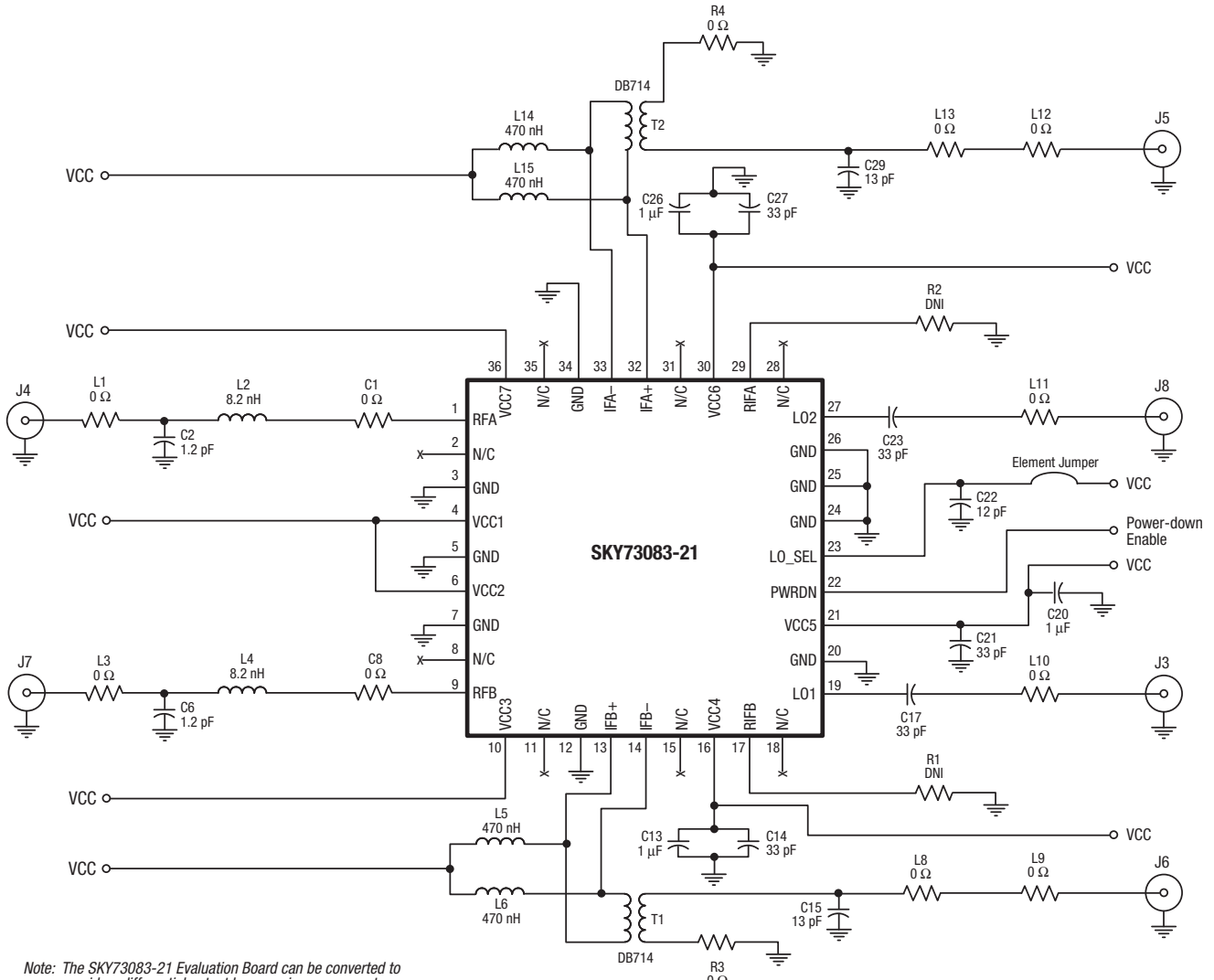
Layer 3: Power Plane



Layer 4: Solid Ground Plane

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Figure 4. SKY73083-21 Evaluation Board Layer Detail



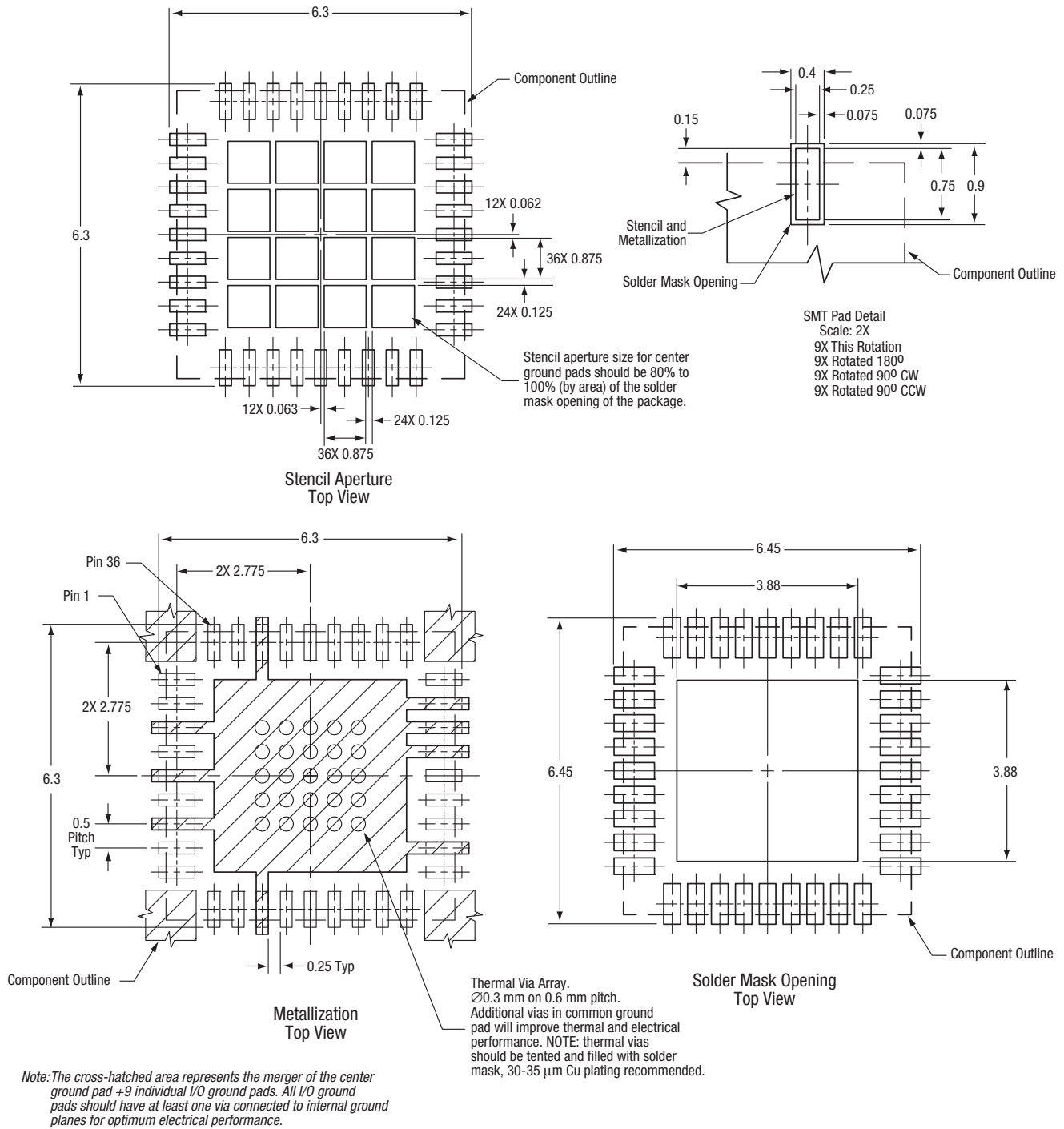
Note: The SKY73083-21 Evaluation Board can be converted to provide a differential output by removing components T1, T2, R3, and R4.

Some component labels may be different than the corresponding component symbol shown here. Component values, however, are accurate as of the date of this Data Sheet.

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Figure 5. SKY73083-21 Evaluation Board Schematic

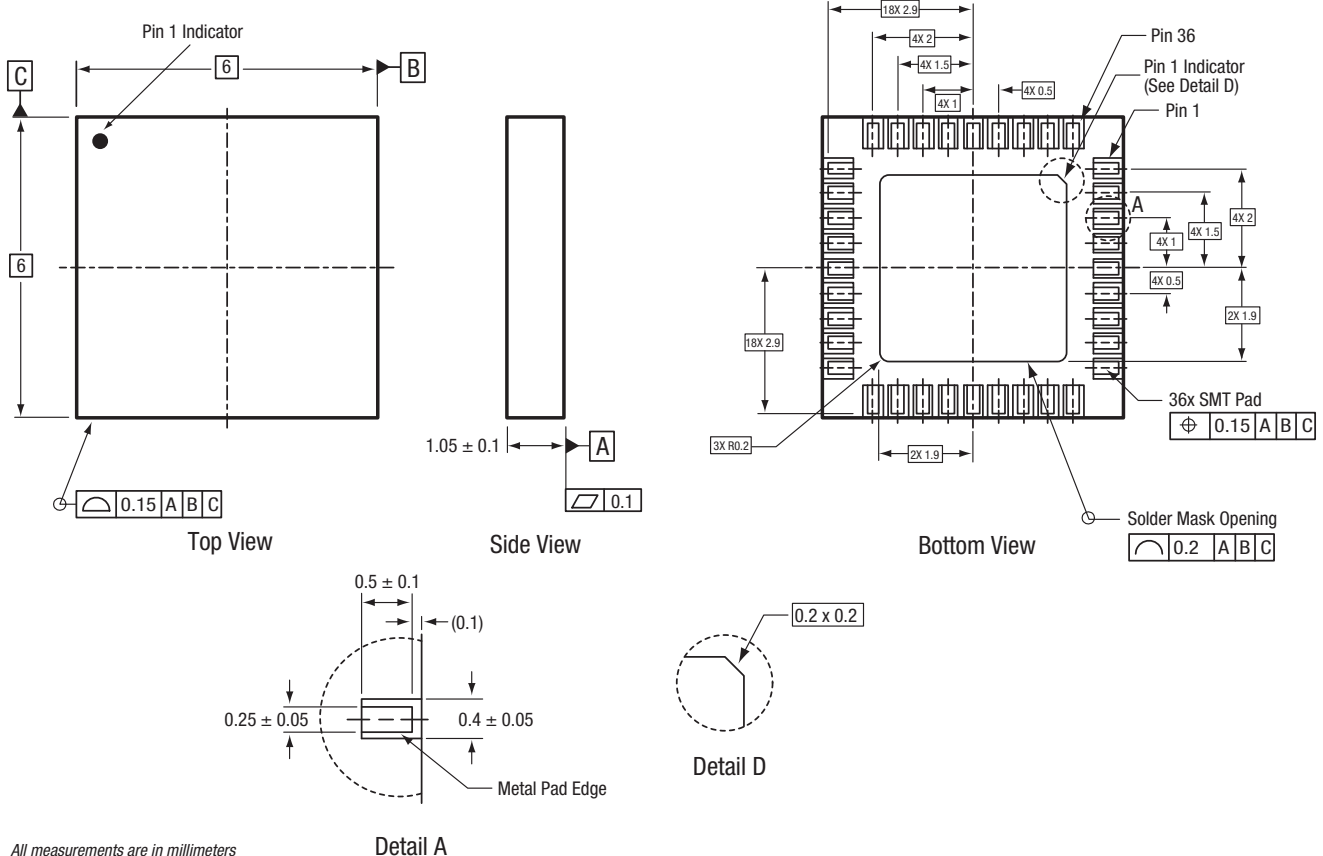
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All measurements are in millimeters

S1125

Figure 6. PCB Layout Footprint for the SKY73083-21 6 x 6 mm MCM



All measurements are in millimeters

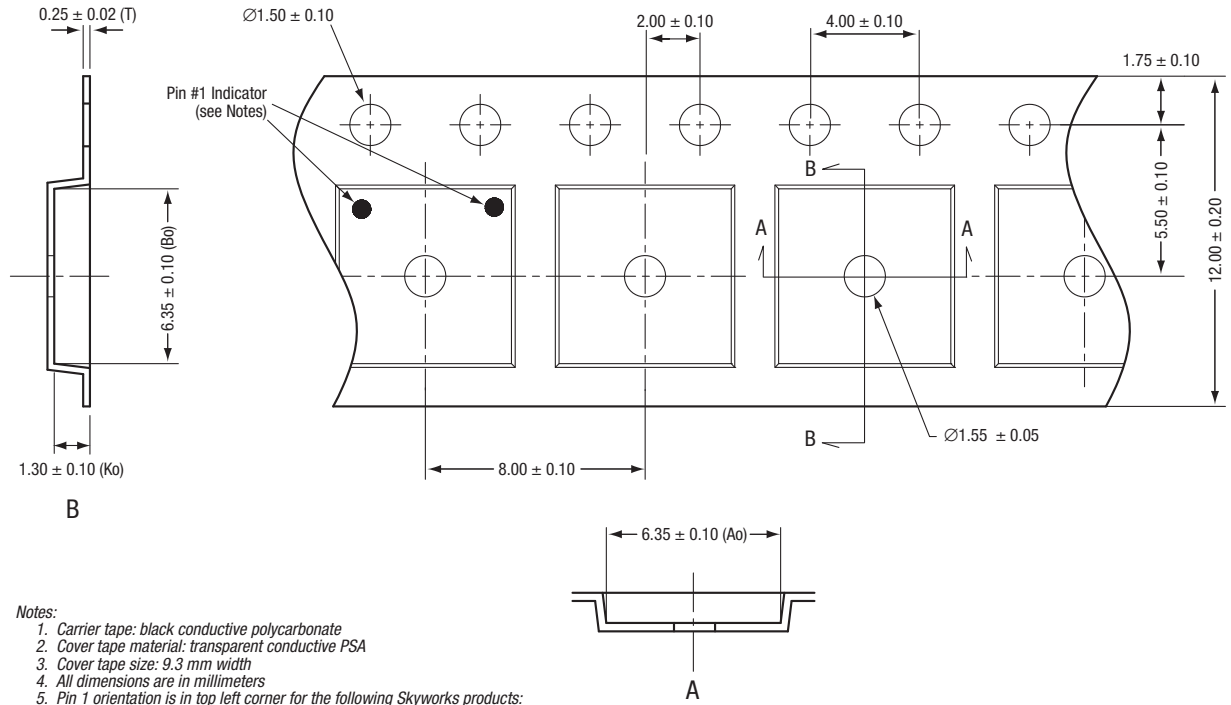
Pads are solder mask defined on one edge and metal defined on three edges.

Dimensioning and tolerancing according to ASME Y14.5M-1994

S1834

Figure 7. SKY73083-21 36-Pin MCM Package Dimensions

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- Notes:
1. Carrier tape: black conductive polycarbonate
 2. Cover tape material: transparent conductive PSA
 3. Cover tape size: 9.3 mm width
 4. All dimensions are in millimeters
 5. Pin 1 orientation is in top left corner for the following Skyworks products:

SKY73022-21, -31
 SKY73023-21, -31

For all other 6 x 6 mm MCM/RFLGA products, pin 1 orientation is in top right corner.

S1850

Figure 8. SKY73083-21 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY73083-21 1700-2200 MHz Downconversion Mixer	SKY73083-21	TW18-D730

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