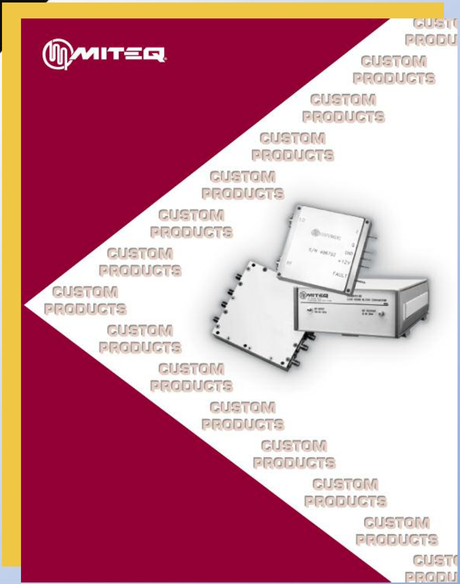

MITEQ
CUSTOM PRODUCTS

TABLE OF CONTENTS (CONT.)

CONTENTS

CUSTOM PRODUCTS

GENERAL

The MITEQ technical advantage of producing custom integrated assemblies are based on the core mature component product lines which include:

- **State-of-the-art low noise amplifiers (LNAs)**
- **High power amplifiers (HPAs)**
- **Wide bandwidth and high dynamic range mixers**
- **Switches and other control products**
- **Low phase noise oscillators and synthesizers**

A sampling of some of the custom subassemblies are shown below. For an individualized quotation, please contact MITEQ with your specific requirement.

MODEL NUMBERS	INPUT FREQUENCY (GHz)	OUTPUT FREQUENCY	DESCRIPTION	PAGE
ARS309LC7	9 to 9.2	50 to 70 MHz	Three-Channel LNA Downconverter Module	467
LNB-1826-30	18 to 26	2 to 10 GHz	Low-Noise Block Downconverter	469
LNB-2640-40	26 to 40	2 to 16 GHz	Low-Noise Block Downconverter	471
DA40502LC7	.5 to 2	10 to 250 MHz	Four-Channel Downconverter Module	473
DA40208LC7	2 to 8	10 to 250 MHz	Four-Channel Downconverter Module	473
DA40818LC7	8 to 19	10 to 250 MHz	Four-Channel Downconverter Module	473
DSS0818	8 to 18	80 to .240 MHz	Five-Channel Downconverter Module with Input RF Switch/Limiter and LO Amplifier/Divider	475
SYS40118C20	1 to 18	20 to 200 MHz	Four-Channel 1 to 18 GHz Image Rejection Downconverter	479
IR3A8596LR6	8.5 to 9.6	10 to 250 MHz	Three-Channel Mixer Amplifier	480
IR3A5459LR6	5.4 to 5.9	10 to 250 MHz	Three-Channel Mixer Amplifier	481
SYS6474N01R	6.4 to 7.4	6.4 to 7.4 GHz	Direct Microwave Digital I/Q Modulator System	483
SYSTX3638	1.5 to 2.5	36.5 to 37.5 GHz	Integrated Upconverter and Power Amplifier	485
SYS1840A24R	18 to 40	2 to 16 GHz	Block Downconverter	487
SYS1840N01R	18 to 40	4 to 18 GHz	Low-Noise Block Downconverter	489
LNB-7181-02	7.1 to 8.1	1 to 2 GHz	X-Band Low-Noise Block Converter	491
SYS3436N01R	34 to 36	34 to 36 GHz	Switched Power Amplifier Assembly	493
SYS0204N01R	2 to 4	55 to 110 MHz	Low-Noise Mixer Preamplifier with Selectable Inputs	494
SYS0118N01R	0.1	1 to 18 GHz	Comb Generator Frequency Multiplier	495
SYS0218N01R	0.1	2 to 18 GHz	Comb Generator Frequency Multiplier	495
SYS0318N01R	0.1	3 to 18 GHz	Comb Generator Frequency Multiplier	495
SYS0518N01R	0.5 to 18	8 to 12 GHz	Broadband Converter	497
SYS9.0N01R	9.28 to 9.34	135 to 185 MHz	X-Band Monopulse Radar Receiver	498
SYS1015N01R	10 to 15	DC to 500 MHz	Dual-Channel Signal Processor Assembly	499
SYS0216N01R	18 to 40	2 to 16 GHz	Dual-Channel Block Converter	501

TYPICAL SUBSYSTEM WORKSHEET

	LNA 26 – 40 GHz	LOWPASS FILTER 40 GHz	MIXER TB0440LW1	LNA 2 – 18 GHz	CASCADE TOTAL
STAGE	1	2	3	4	
Noise figure (dB)	2.75	0.5	9	2.5	2.82
Gain (dB)	27	-0.5	-9	20	37.5
Output IP^3 (dBm)	18	100	4	20	18.13
Output power (dBm)	-13	-13.5	-22.5	-2.5	–

USEFUL SYSTEM FORMULAS

$$NF = \text{Noise Temperature} = 1 + \frac{T_e}{T_o}$$

T_e = Excess Noise Temperature = $(NF - 1)\,T_o$, $T_o = 290$ K

$$\text{Overall Cascaded Noise Temperature} = NF_1 + \frac{NF_2 - 1}{G_1} + \frac{NF_3 - 1}{G_1 G_2} + \frac{NF_4 - 1}{G_1 G_2 G_3}$$

$$\text{Overall Cascaded Noise Temperature} = Te_1 + \frac{Te_2}{G_1} + \frac{Te_3}{G_1 G_2} + \frac{Te_4}{G_1 G_2 G_3}$$

IP2 Output Cascaded (worst case), $(IP2)^{-1/2} = (IP2_4)^{-1/2} + (G_4 IP2_3)^{-1/2} + (G_3 G_4 IP2_2)^{-1/2} + (G_2 G_3 G_4 IP2_1)^{-1/2}$

IP3 Output Cascaded (worst case), $(IP3)^{-1} = (IP3_4)^{-1} + (G_4 IP3_3)^{-1} + (G_3 G_4 IP3_2)^{-1} + (G_2 G_3 G_4 IP3_1)^{-1}$

Note: All quantities expressed as power ratios.

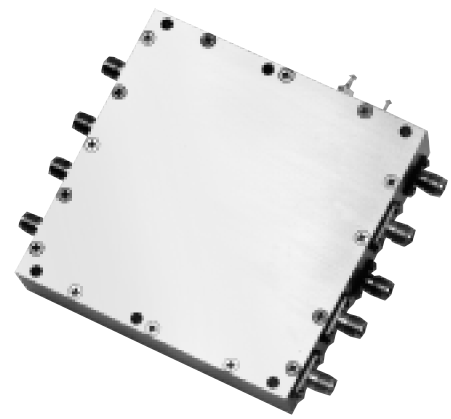
CUSTOM PRODUCTS

THREE-CHANNEL LNA DOWNCONVERTER MODULE

MODEL: ARS309LC7

FEATURES

- **RF/LO coverage .... 9 to 9.3 GHz**
- **Input limiter diode protection**
- **Conversion gain .... 17 dB typical**
- **Noise figure .... 5 dB typical**
- **Channel-to-channel tracking (typical)**
  Phase .... ±5°
  Amplitude .... ±0.5 dB



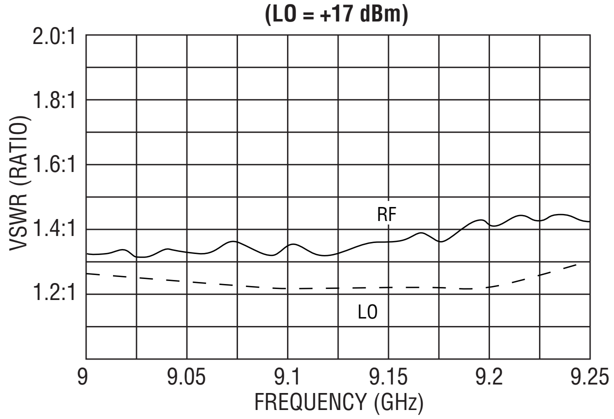
MITEQ's Model ARS3 Series integrates our best low-noise amplifier and double-balanced image rejection mixer designs. Input limiter protection diodes and output IF amplifiers provide a phase and amplitude tracking three-channel downconverter with an integrated BIT and LO distribution network. This unit can be used in a basic monopulse receiver. In addition, a mating three-channel IF (AGC) unit and I/Q video detector assembly is available.

ELECTRICAL SPECIFICATIONS

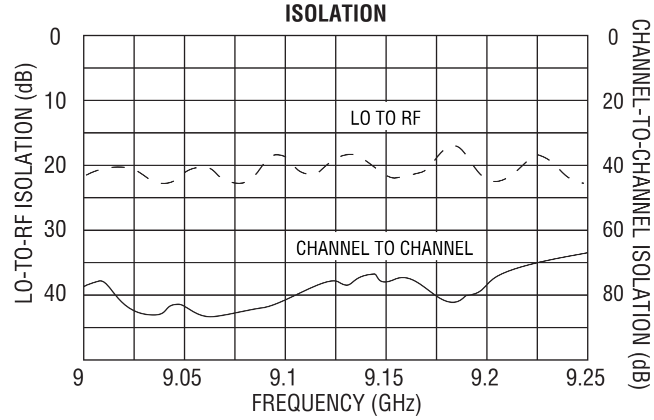
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF/LO frequency range		GHz	9		9.3
RF VSWR (RF = -30 dBm, LO = +17 dBm)		Ratio			1.5:1
BIT (built-in-test) common port		GHz	9		9.3
Maximum RF input power	CW	Watts	1		
	Pulse (1µs, 1% duty cycle)	Watts	50		
LO power range		dBm	+16		+18
LO VSWR	LO = +17 dBm	Ratio		2:1	3:1
DC voltage/current	Positive and negative	V/mA	-15/-0.5		+15/2.5
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain	RF input to IF output	dB	15	17	
Single-sideband noise figure at 25°C		dB		5	5.5
BIT phase tracking		Degrees	-5		+5
LO-to-RF isolation		dB	20	25	
RF-to-IF isolation		dB		±0.5	±1
Output power at 1 dB compression	LO = +17 dBm	dBm		+10	
Output two-tone third-order intercept point	LO = +17 dBm	dBm		+20	
Channel-to-channel phase tracking		Degrees		±5	±10
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		MHz	50		70
IF phase linearity	3-pole butterworth	Degrees	-5		+5
IF VSWR		Ratio		2:1	2.5:1

ARS309LC7 TYPICAL TEST DATA

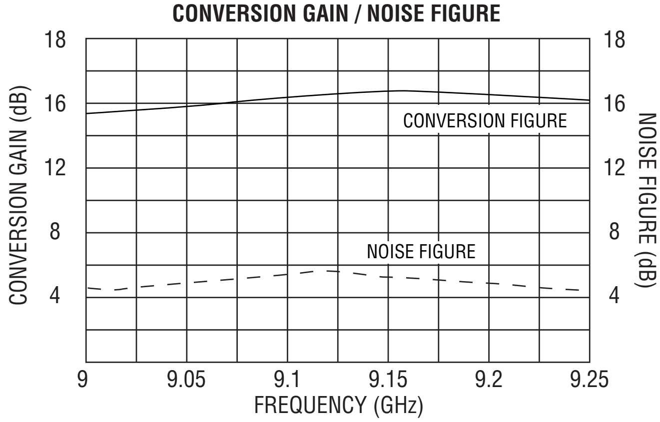
VSWR (LO = +17 dBm)



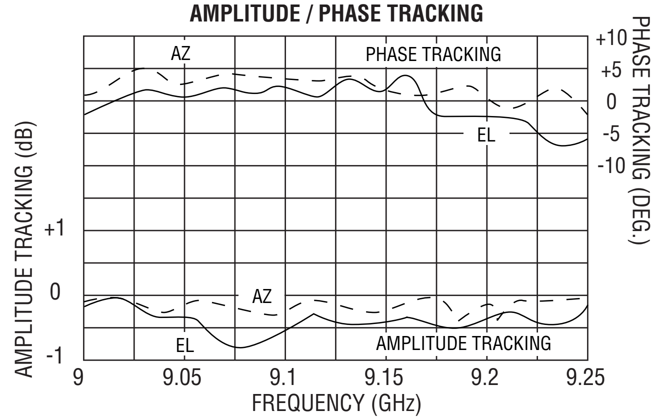
ISOLATION



CONVERSION GAIN / NOISE FIGURE



AMPLITUDE / PHASE TRACKING



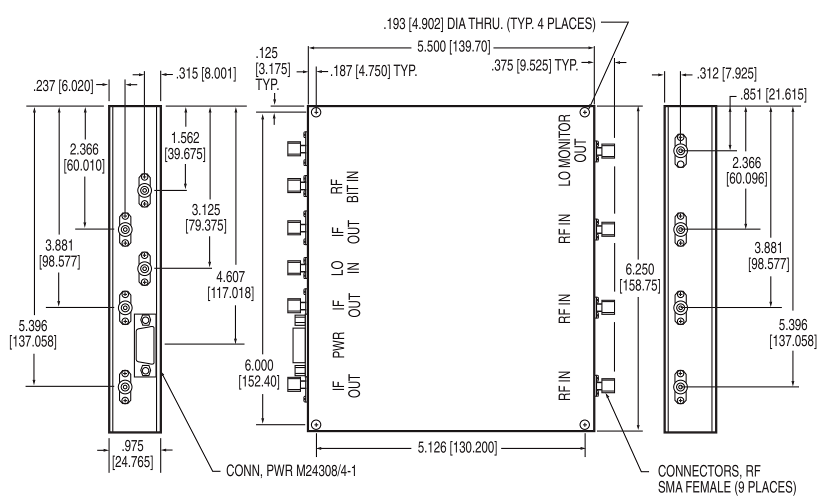
MAXIMUM RATINGS

Operating temperature .... -40 to +65°C
Storage temperature .... -55 to +100°C

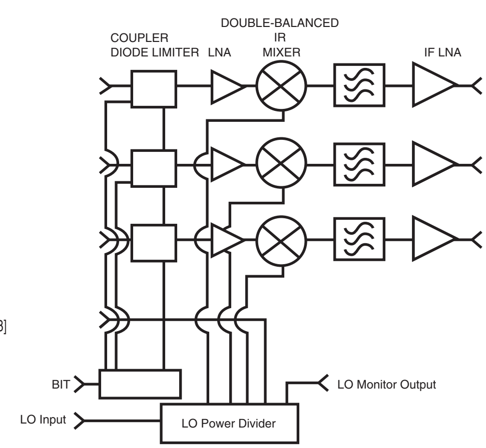
AVAILABLE OPTIONS

AGC, IF module.
I/Q detector module.
Digital output.

OUTLINE DRAWING



FUNCTIONAL BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

CUSTOM PRODUCTS

LOW-NOISE BLOCK DOWNCONVERTERS

MODEL SERIES: LNB-1826-30

FEATURES

- **RF frequency range.......... 18 to 26 GHz**
- **Conversion gain .... 42 dB typical**
- **Noise figure....................... 3 dB maximum**

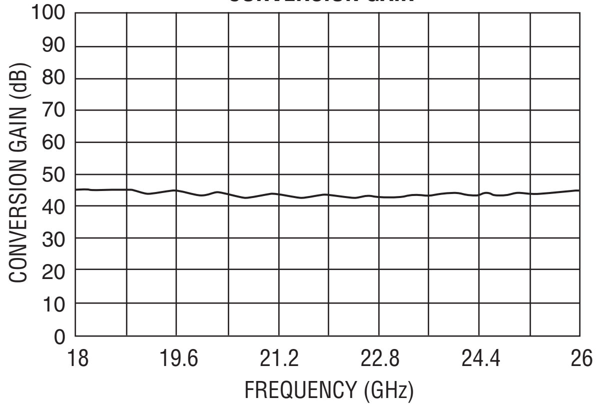
These wide RF/IF bandwidth frequency converters, with fixed LO frequencies (block converters), are commonly used to process millimeter signals with less expensive receivers below 18 GHz. In some applications, the resulting signals are upconverted back into the millimeter band. The LNB series, with its 4 dB noise figure, permits operation at low input signal powers. In addition, the PM noise of the converter is minimized by a phase-locked and multiplied internal LO source. The block diagram shown above is a baseline configuration. **ALTERNATIVE CONFIGURATIONS ARE AVAILABLE.**

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF frequency range		GHz	18		26
RF VSWR	50 ohm reference	Ratio			2.5:1
LO frequency (fixed, internal)		GHz		28	
Reference input frequency		MHz	10		
Reference input power		dBm	0		
DC power	+15 VDC	Amp	1		
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain		dB		42	
Single-sideband noise figure at 25°C		dB		2.5	3
LO-to-RF isolation		dB	45		
LO-to-IF isolation		dB		30	
RF-to-IF isolation		dB		20	
Output power at 1 dB compression		dBm	+7		
Output two-tone third-order intercept point		dBm	+17		
Image rejection		dB	20	25	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		GHz	2		10
IF VSWR	50 ohm reference	Ratio			2.5:1

LNB-1826-30 TYPICAL TEST DATA

CONVERSION GAIN



NOISE FIGURE

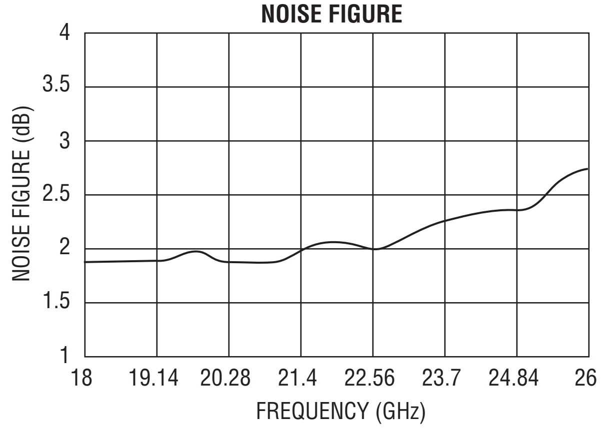
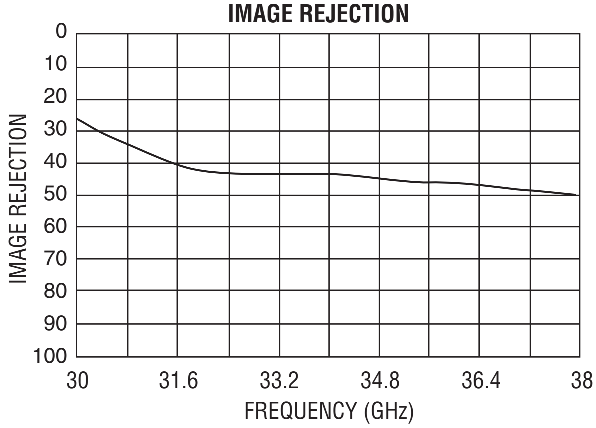
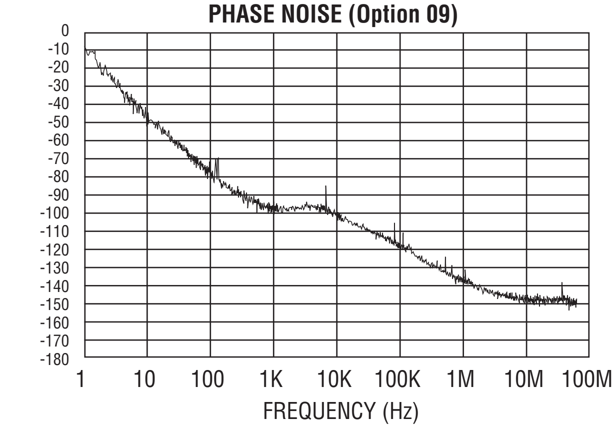


IMAGE REJECTION



PHASE NOISE (Option 09)



ENVIRONMENTAL CONDITIONS

Specification temperature .... +25°C
Storage temperature .... -55 to +85°C minimum
Humidity .... 95% noncondensing

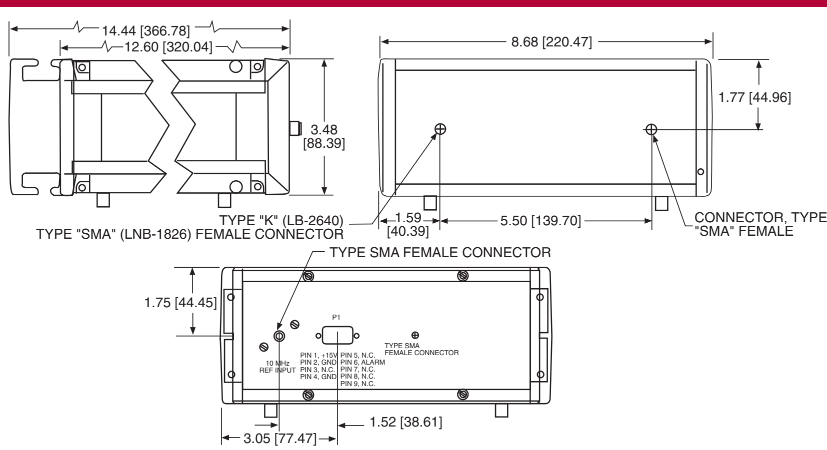
NOTE: Test data supplied at 25°C; conversion gain, noise figure and 1 dB compression point.

AVAILABLE OPTIONS

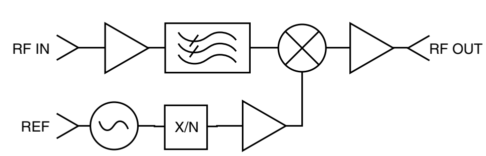
Option	Number
01	LO frequency set at 16 GHz, LO < RF operation.
02	Bias (contact MITEQ).
03	Conversion gain (contact MITEQ).
04	Noise figure (contact MITEQ).
05	+10 dB minimum output 1 dB compression point.
06	Additional environmental conditions (contact MITEQ).
07	Mechanical, RF input, WR42 waveguide.
08	External LNA for remote feed applications.
09	Low phase noise LO utilizing an internal reference with frequency stability to ±1 PPM.

NOTE: When ordering, please specify model number and option number(s) required.

OUTLINE DRAWING



BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

MODEL SERIES: LNB-2640-40

FEATURES

- **RF frequency range.......... 26 to 40 GHz**
- **Conversion gain .... 42 dB typical**
- **Noise figure....................... 4 dB maximum**

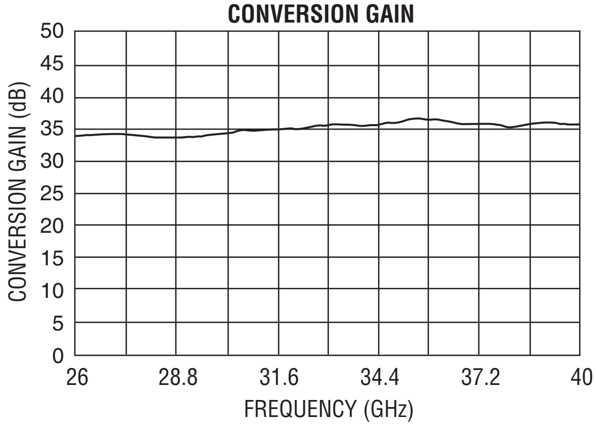
These wide RF/IF bandwidth frequency converters, with fixed LO frequencies (block converters), are commonly used to process millimeter signals with less expensive receivers below 18 GHz. In some applications, the resulting signals are upconverted back into the millimeter band. The LNB series, with its 4 dB noise figure permits operation at low input signal powers. In addition, the PM noise of the converter is minimized by a phase-locked and multiplied internal LO source. The block diagram shown above is a baseline configuration. **ALTERNATIVE CONFIGURATIONS ARE AVAILABLE.**

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	26		40
RF VSWR	50 ohm reference	Ratio		2.5:1	
LO frequency (fixed, internal)		GHz		42	
Reference input frequency		MHz	10		
Reference input power		dBm	0		
DC power	+15 VDC	Amp	1		
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain		dB		42	
Single-sideband noise figure at 25°C		dB		3.5	4
LO-to-RF isolation		dB	45		
LO-to-IF isolation		dB		30	
RF-to-IF isolation		dB		20	
Output power at 1 dB compression		dBm	+7		
Output two-tone third-order intercept point		dBm	+17		
Image rejection		dB	20	25	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		GHz	2		16
IF VSWR	50 ohm reference	Ratio			2.5:1

LNB-2640-40 TYPICAL TEST DATA

CONVERSION GAIN



NOISE FIGURE

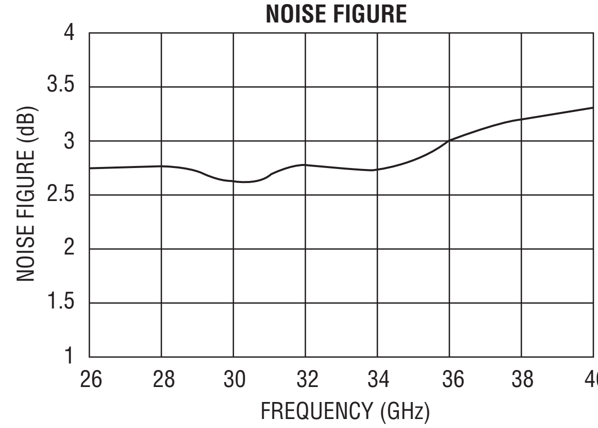
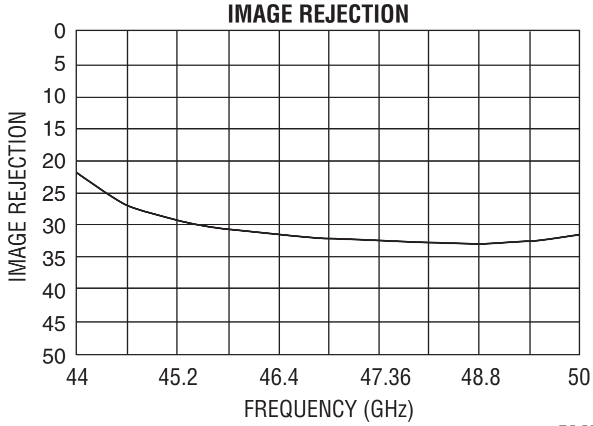
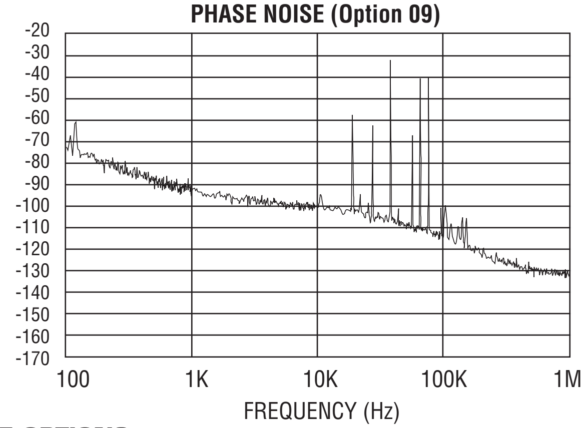


IMAGE REJECTION



PHASE NOISE (Option 09)



AVAILABLE OPTIONS

Option	Number
01	LO frequency set at 24 GHz, LO < RF operation.
02	Bias (contact MITEQ).
03	Conversion gain (contact MITEQ).
04	Noise figure (contact MITEQ).
05	+10 dB minimum output 1 dB compression point.
06	Additional environmental conditions (contact MITEQ).
07	Mechanical, RF input, WR28 waveguide.
08	External LNA for remote feed applications.
09	Low phase noise LO utilizing an internal reference with frequency stability to ±1 PPM.

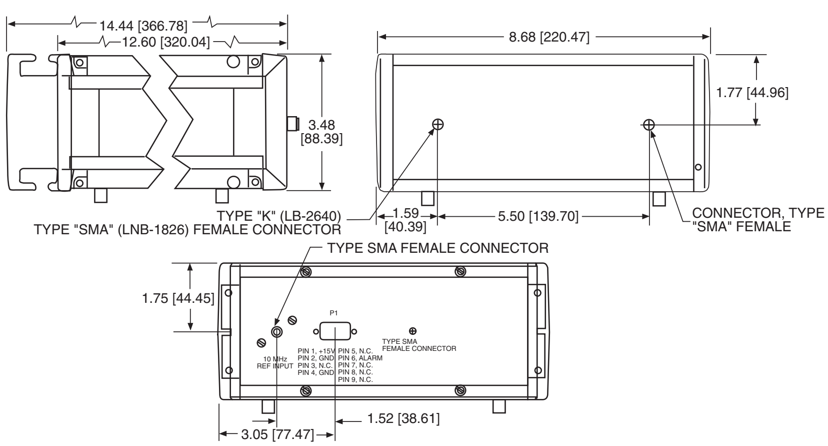
NOTE: When ordering, please specify model number and option number(s) required.

ENVIRONMENTAL CONDITIONS

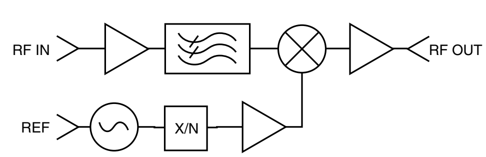
Specification temperature ...... +25°C
Storage temperature .... -55 to +85°C minimum
Humidity .... 95% noncondensing

NOTE: Test data supplied at 25°C; conversion gain, noise figure and 1 dB compression point

OUTLINE DRAWING



BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

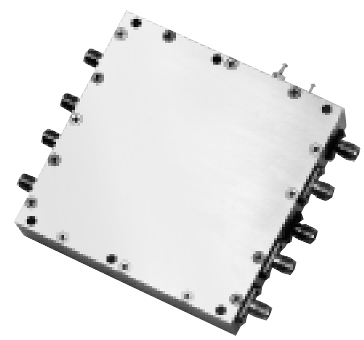
CUSTOM PRODUCTS

FOUR-CHANNEL DOWNCONVERTER MODULE

MODEL SERIES: DA4

FEATURES

- **RF/LO coverage .... 0.5 to 18 GHz**
- **Input limiter diode protection**
- **Conversion gain .... 25 dB typical**
- **Noise figure....................... 8.5 dB typical**
- **Channel-to-channel tracking**
  Phase .... ±5° typical
  Amplitude .... ±0.5 dB typical



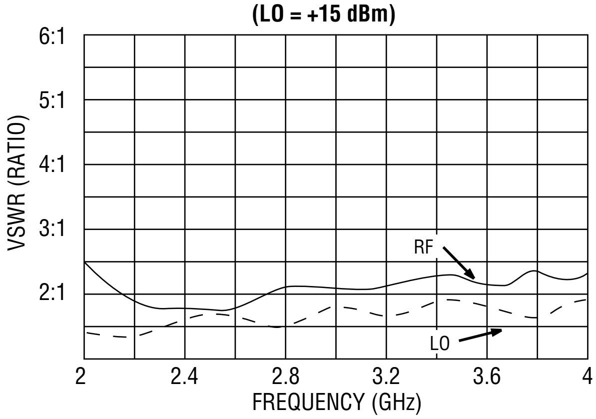
MITEQ's Model DA4 Series integrates our standard broadband double-balanced mixer designs with input limiter protection diodes and IF amplifiers to provide a phase- and amplitude-tracked four-channel downconverter with an integrated LO distribution network. This unit can be used for basic direction finding (D.F.) experiments with four antennas. In addition, three of the four channels can also be used for a monopulse radar receiver and the fourth used for spur identification.

ELECTRICAL SPECIFICATIONS

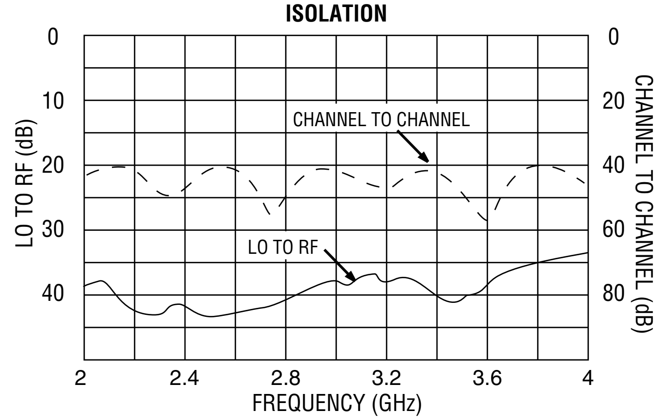
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF/LO frequency range	DA40502LC7 DA40208LC7 DA40818LC7	GHz GHz GHz	0.5 2 8		2 8 18
Maximum RF input power	CW	Watts	1		
	Pulse (1μs, 1% duty cycle)	Watts	50		
LO power range		dBm	+13	+15	
RF and LO VSWR (RF = -10 dBm, LO = +15 dBm)		Ratio		2:1	3:1
DC bias +15 V		mA		150	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain (RF input to IF output)		dB	23	25	
Single-sideband noise figure at 25°C	0.5 to 4 GHz 4 to 18 GHz	dB dB		8 9	10 11
LO-to-RF isolation		dB	20	25	
LO-to-IF isolation		dB		20	
RF-to-IF isolation		dB		20	
Output power at 1 dB compression	LO = +15 dBm	dBm		+10	
Output two-tone third-order intercept point	LO = +15 dBm	dBm		+20	
Channel-to-channel amplitude tracking		dB		±0.5	±1
Channel-to-channel phase tracking		Degrees		±5	±10
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		MHz	10		250
IF VSWR (IF = -10 dBm, LO = +15 dBm)		Ratio		2:1	

DA40204L TYPICAL TEST DATA

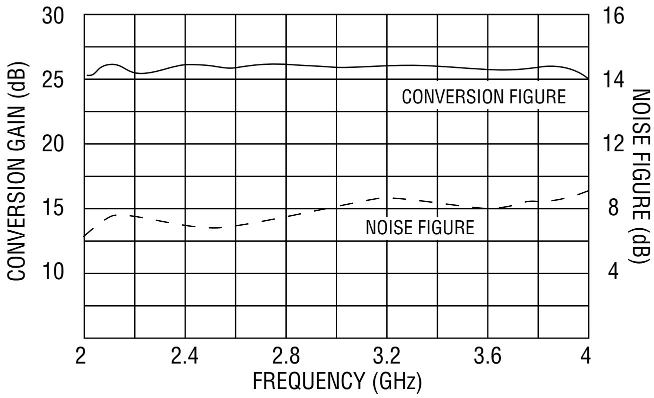
VSWR (LO = +15 dBm)



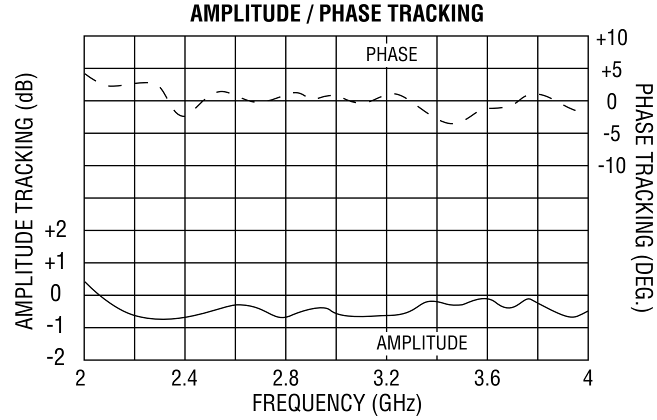
ISOLATION



CONVERSION GAIN / NOISE FIGURE



AMPLITUDE / PHASE TRACKING



MAXIMUM RATINGS

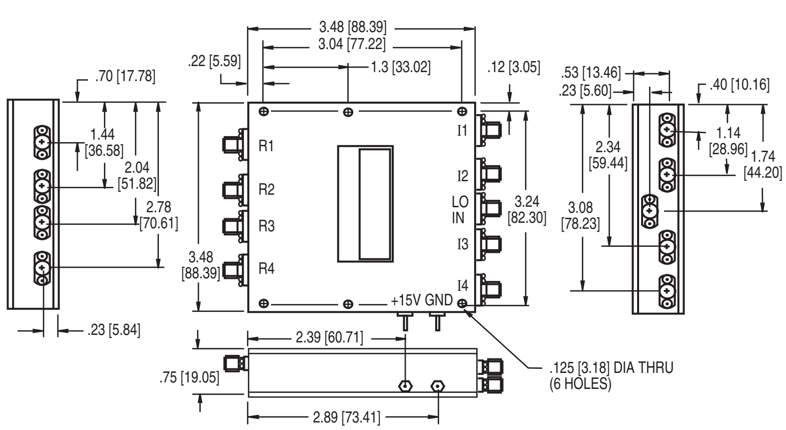
Operating temperature .... -54 to +85°C
Storage temperature .... -65 to +125°C

AVAILABLE OPTIONS

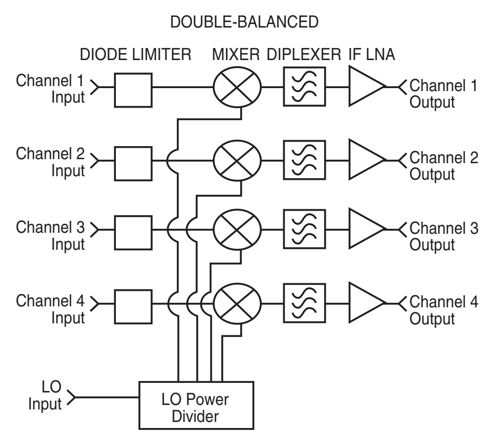
Multioctave RF coverage.
RF built-in-test (BIT) input.
Microwave IF coverage.
High dynamic range operation.

NOTE: Test data supplied at 25°C; conversion gain, LO-to-RF isolation, noise figure, amplitude and phase balance.

OUTLINE DRAWING



FUNCTIONAL BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

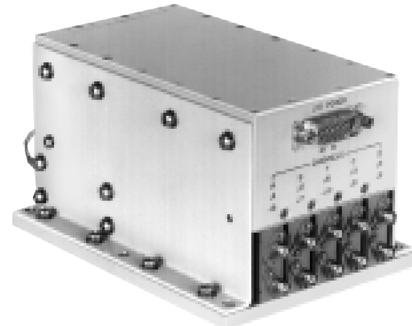
CUSTOM PRODUCTS

FIVE-CHANNEL DOWNCONVERTER MODULE WITH INPUT RF SWITCH/LIMITER AND LO AMPLIFIER/DIVIDER

MODEL SERIES: DSS0818

FEATURES

- RF/LO coverage .... 8 to 18 GHz
- Ideal for broadband DF receivers
- External IF phase/amplitude adjustments
- Channel-to-channel RF tracking
  Phase .... ±5° typical
  Amplitude .... ±0.5 dB typical
- Remote band/blanking/BIT selection

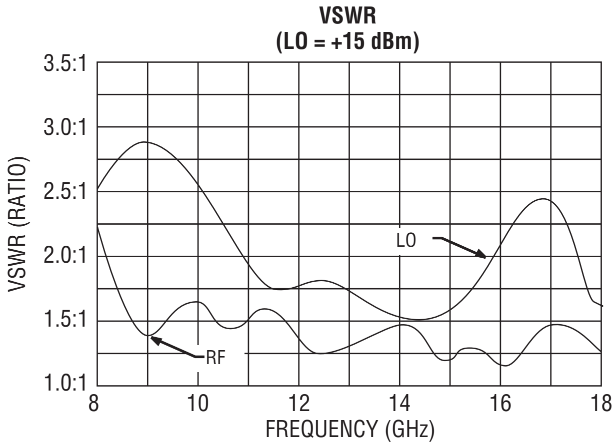


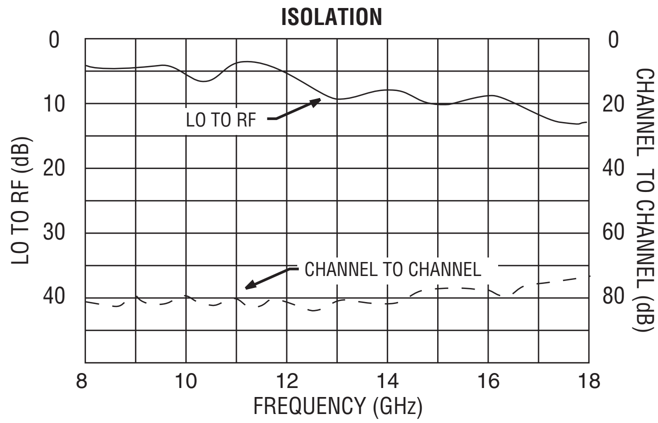
MITEQ's Model DSS Series integrates our standard broadband double-balanced mixer designs with input limiter protection diodes and IF amplifiers to provide a phase- and amplitude-tracked five-channel downconverter with an integrated LO amplifier/splitter. A three-way input switch/limiter provides remote band/blanking/BIT select and protection from undesired high signal levels. This module is most often used as the "front-end" of a direction-finding system using four antennas in the azimuth, elevation or combined directions and a fifth antenna channel to resolve additional received strong "back or side lobe" signals and to identify the receiver image response. The DSS0818 is also useful as an instantaneous frequency monitor with suitable input frequency to phase encoders (application notes available).

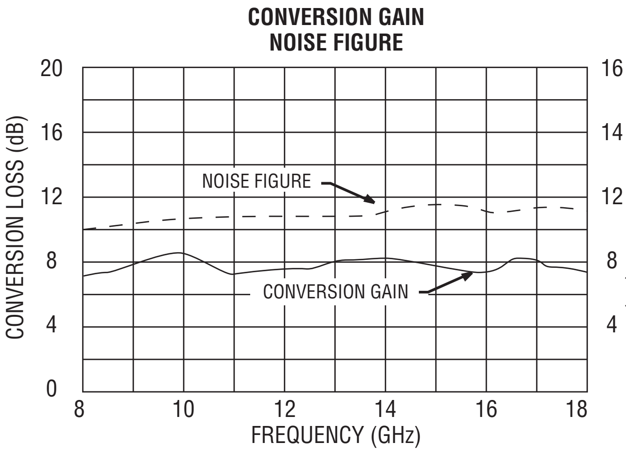
ELECTRICAL SPECIFICATIONS

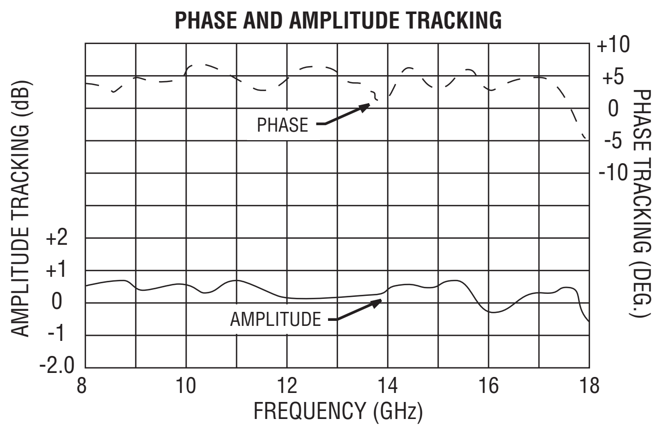
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF/LO frequency range	LO_1 and LO_2	GHz	8		18
RF power, 1 dB compression	@ 6 dB gain nominal	dBm		-7	
RF power	Maximum average	Watts		2	
RF power (maximum peak, 5 μs pulse, 1% duty cycle)		Watts		200	
LO power, operating	LO_1 and LO_2	dBm	-18	-15	-12
RF and LO VSWR (RF = -10 dBm, LO = -15 dBm)		Ratio		1.5:1	
BIT (built-in-test) control (3 BITS)		Logic		TTL	
DC current at ±12 V		mA		700	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain (RF input to IF output, with gain adjustment of ±5 dB)		dB	3	8	13
Conversion gain flatness	Across RF band	±dB		1	
Single-sideband noise figure at 25°C		dB		10	14
LO-to-RF isolation	Including LO amplifier gain	dB	0	5	10
LO-to-IF isolation		dB		50	
RF-to-IF isolation		dB		60	
Output two-tone third-order intercept point	LO = -15 dBm	dBm		+25	
Output two-tone second-order intercept point		dBm		+48	
Channel-to-channel isolation		dB		40	
Channel-to-channel amplitude tracking		dB		±0.5	±1
Channel-to-channel phase tracking		Degrees		±5	±15
IF gain adjust		±dB			5
IF phase adjust		±Degrees			20
OUTPUT PARAMETERS		**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	-3 dB bandwidth	MHz	80	160	240
IF VSWR (IF = -10 dBm, LO = -15 dBm)	Ratio		2:1		

DSS0818 TYPICAL TEST DATA

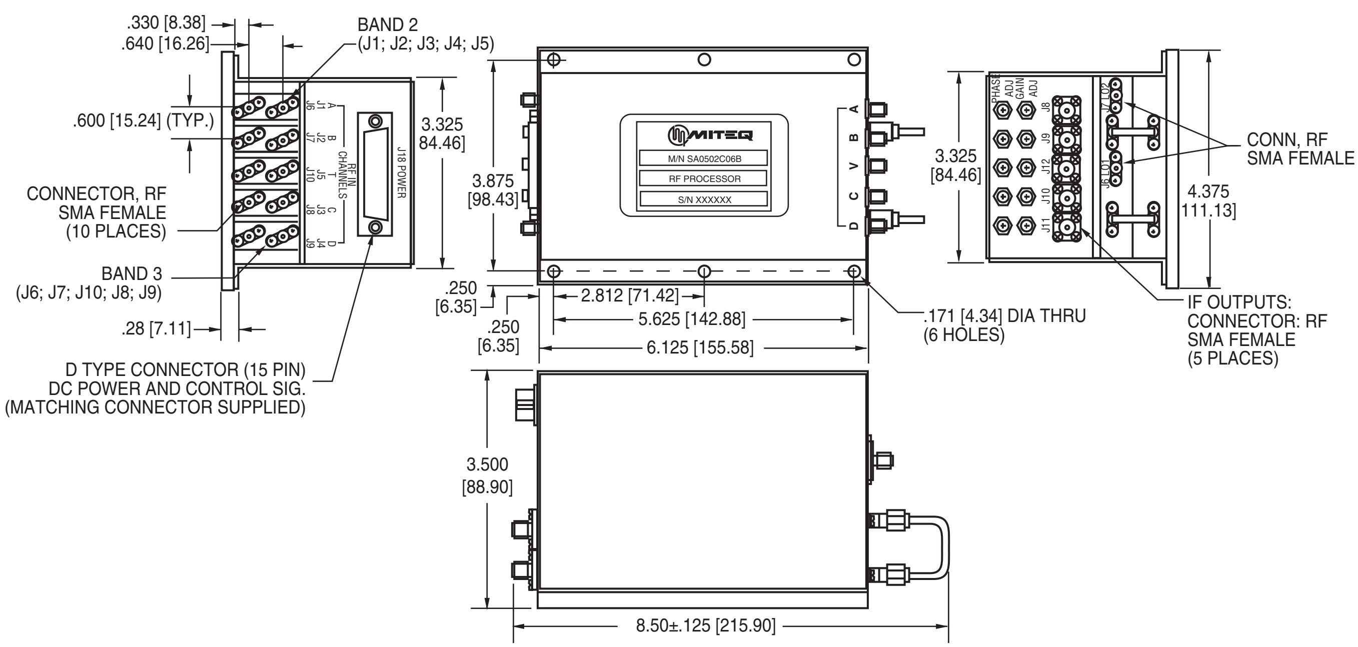








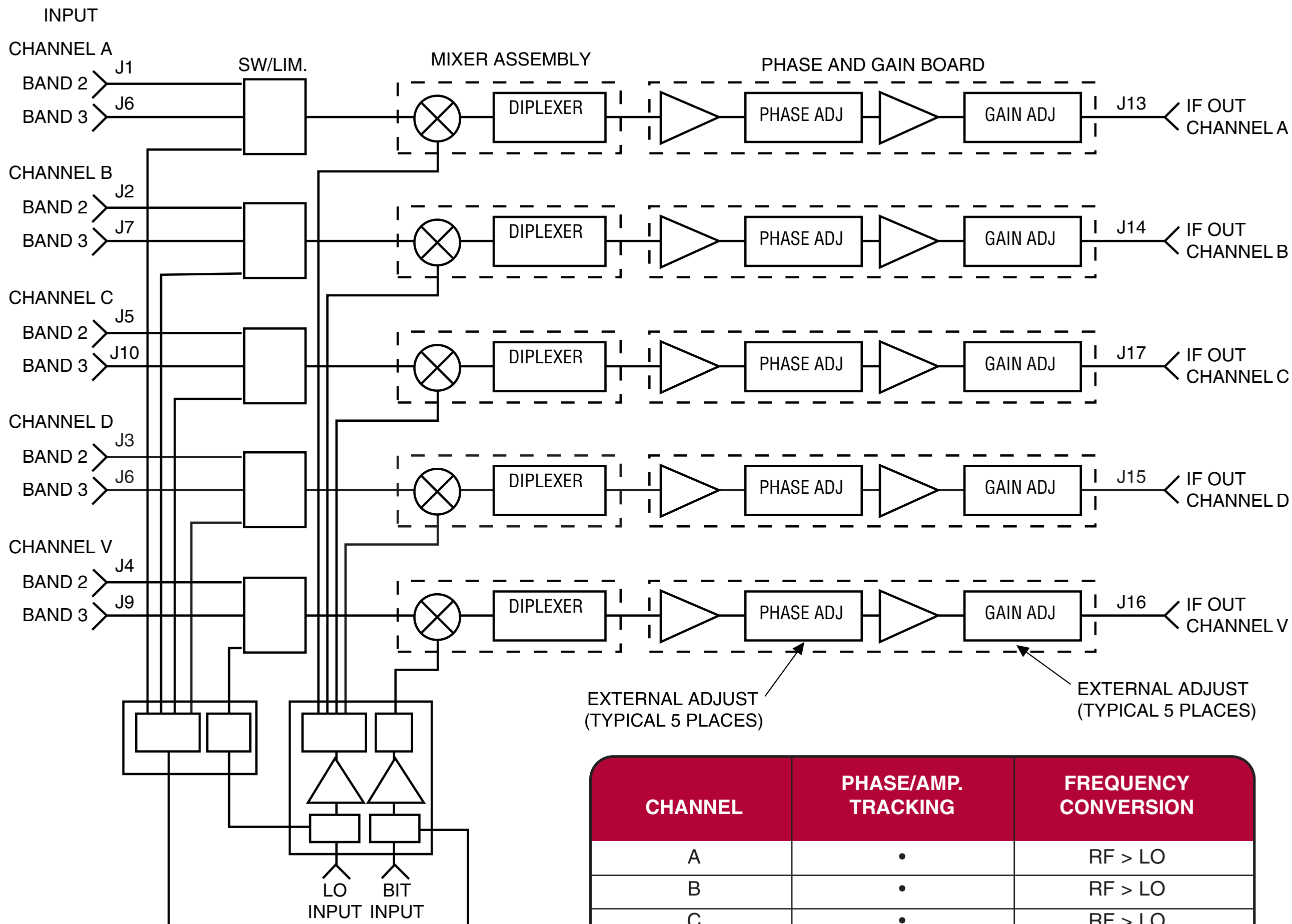
OUTLINE DRAWING



NOTE: All dimensions shown in brackets [ ] are in millimeters.

CUSTOM PRODUCTS

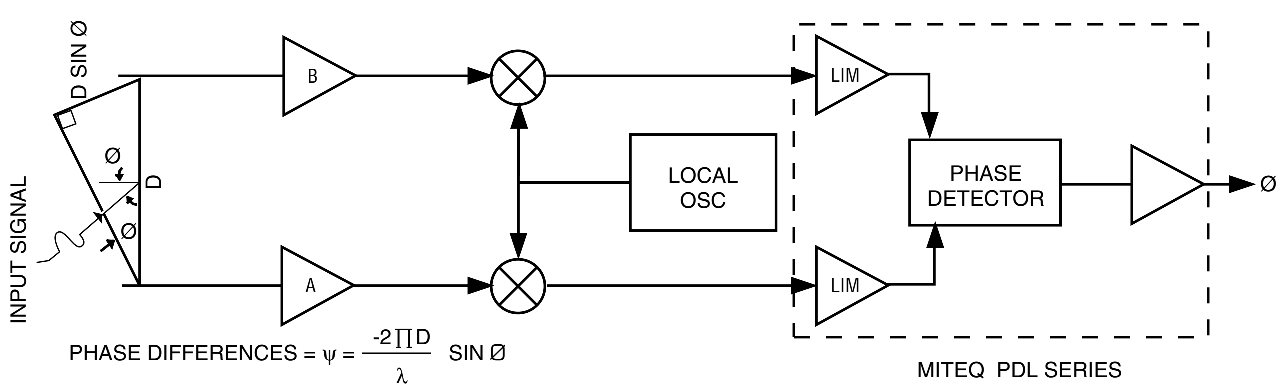
BLOCK DIAGRAM OF MITEQ 5-CHANNEL GAIN- AND PHASE-MATCHED FRONT END



CHANNEL	PHASE/AMP. TRACKING	FREQUENCY CONVERSION
A	•	RF > LO
B	•	RF > LO
C	•	RF > LO
D	•	RF > LO
T		RF < LO

APPLICATION NOTES

BLOCK DIAGRAM OF SIMPLE TWO-CHANNEL ANGLE OF ARRIVAL (A.O.A) MEASUREMENT SYSTEM (REF 1.)

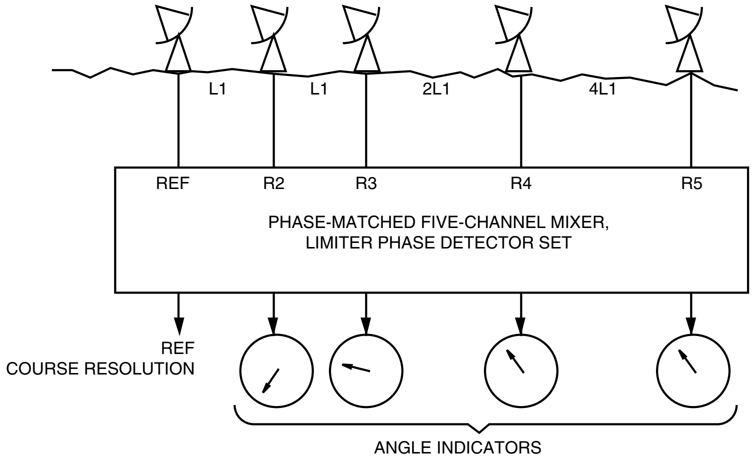


PHASE DIFFERENCES = $\psi = \frac{-2\prod D}{\lambda}$ SIN Ø

1. “Microwave Passive Direction Finding”, S. Lipsky, 1987, John Wiley & Sons publisher TK6565.D5L57.

APPLICATIONS OF FIVE-CHANNEL FRONT ENDS

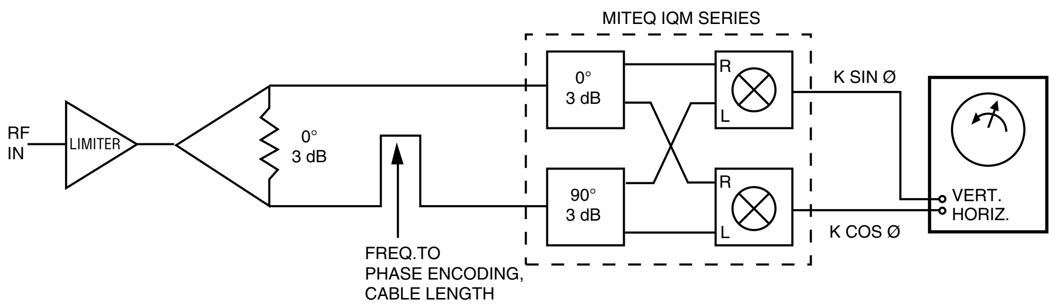
DIRECTION FINDING APPLICATIONS



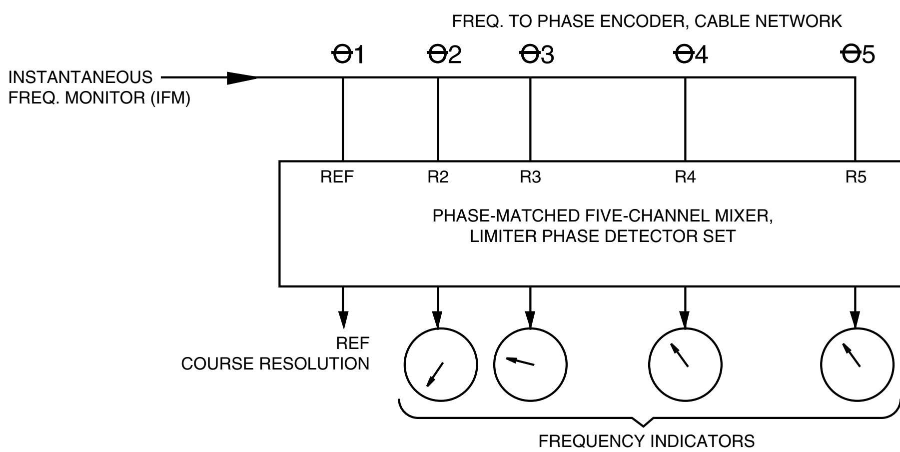
ALTERNATIVE APPLICATIONS

Can the basic direction-finding receiver also be used to measure incoming frequency?

Yes, by first encoding the received signal into two separate outputs that have a phase difference in direct proportion to their frequency:



A large cable length difference in the two splitter outputs will yield rapidly varying phase with frequency. If these outputs are applied to a two-channel DF system, the output phase difference, together with knowledge of the encoder cable lengths, can be used to determine input frequency. This is the basic principle of an instantaneous frequency monitor (IFM). In actual practice, several frequency encoders are used with progressively greater frequency resolution, similar to how one reads the dials of a gas or an electric meter.



FOUR-CHANNEL 1 TO 18 GHz IMAGE REJECTION DOWNCONVERTER

MODEL: SYS40118C20*

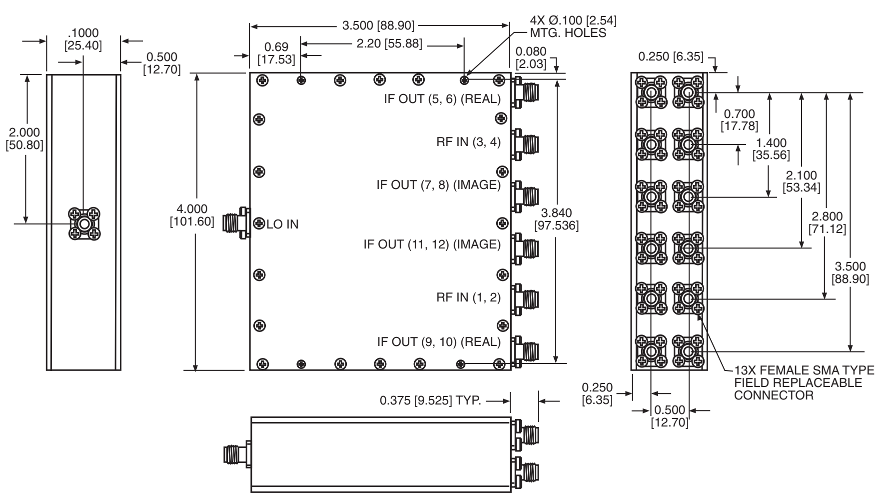
FEATURES

- **Four-amplitude and phase-matched channels**
- **RF/LO coverage .... 1 to 18 GHz**
- **IF option * A: 20 to 40 MHz**
  B: 40 to 80 MHz
  C: 100 to 200 MHz

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	1		18
RF VSWR	LO = +20 dBm	Ratio		3.5:1	
LO frequency range		GHz	1		18
LO VSWR	LO = +20 dBm	Ratio		2.5:1	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF-to-IF conversion loss	LO = +20 dBm	dB			14
Channel to channel	LO = +20 dBm				
Amplitude tracking		dB	-1.5		+1.5
Phase tracking		Degrees	-15		+15
Isolation		dB	30		
Image rejection		dB	15		
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	See IF options below		20		200
IF VSWR	LO = +20 dBm	Ratio		2:1	

OUTLINE DRAWING



NOTE: All dimensions shown in brackets [ ] are in millimeters.

MAXIMUM RATINGS
Specification temperature .... +25°C
Operating temperature .... -54 to +85°C
Storage temperature .... -65 to +125°C

Available IF frequency options:
SYS40118C20*
A: 20 to 40 MHz
B: 40 to 80 MHz
C: 100 to 200 MHz

NOTE: Test data supplied at 25°C; conversion loss, amplitude and phase tracking, channel-to-channel isolation, LO-to-RF isolation and image rejection.

THREE-CHANNEL MIXER AMPLIFIER

MODEL: IR3A8596LR6 *

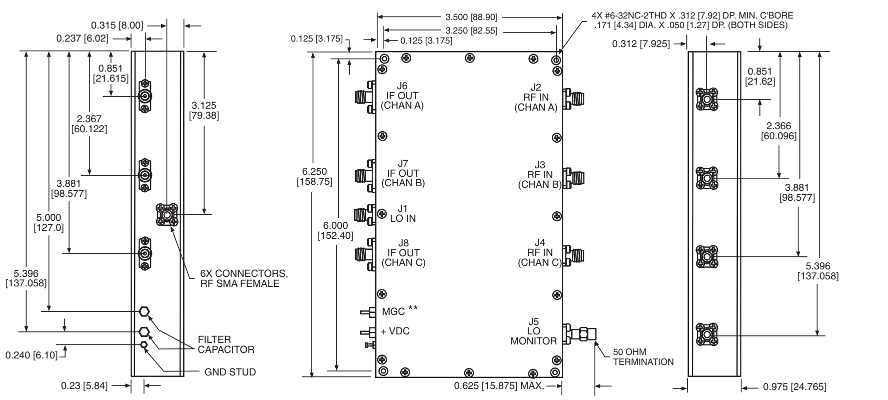
FEATURES

- Three-amplitude and phase-matched channels
- RF/LO coverage .... 8.5 to 9.6 GHz
- IF option * A: 20 to 40 MHz
  B: 40 to 80 MHz
  C: 100 to 200 MHz

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	8.5		9.6
RF VSWR	LO = +13 dBm	Ratio		2:1	
LO frequency range	LO > RF	GHz	8.5		9.6
LO power range		dBm	+13		+16
LO VSWR	LO = +13 dBm	Ratio		1.5:1	
Bias	+15 VDC	mA		150	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF-to-IF conversion gain	LO = +13 dBm	dB		20	
Single-sideband noise figure at 25°C	LO = +13 dBm	dB		6	6.7
Channel to channel	LO = +13 dBm				
Amplitude tracking		dB	-0.5		+0.5
Phase tracking		Degrees	-5		+5
Isolation		dB	30		
Image rejection	LO < RF	dB	20		
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	See IF options below		20		200
IF VSWR	LO = +13 dBm	Ratio		2:1	

OUTLINE DRAWING



** Is optional.

NOTE: All dimensions shown in brackets [ ] are in millimeters.

MAXIMUM RATINGS

Specification temperature .... +25°C
Operating temperature .... -54 to +85°C
Storage temperature .... -65 to +125°C

Available IF frequency options:
IR3A8596LR6 *
A: 20 to 40 MHz
B: 40 to 80 MHz
C: 100 to 200 MHz

NOTE: Test data supplied at 25°C; conversion loss, amplitude and phase tracking, channel-to-channel isolation, LO-to-RF isolation and image rejection.

THREE-CHANNEL MIXER AMPLIFIER

MODEL: IR3A5459LR6 *

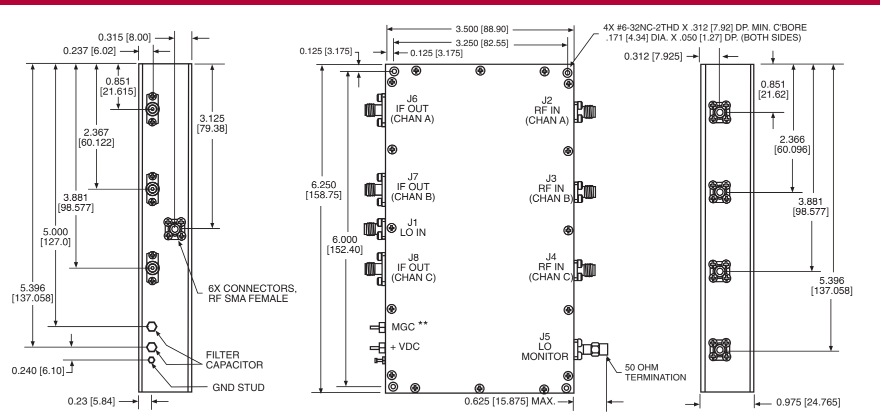
FEATURES

- Three-amplitude and phase-matched channels
- RF/LO coverage .... 5.4 to 5.9 GHz
- IF option * A: 20 to 40 MHz
  B: 40 to 80 MHz
  C: 100 to 200 MHz

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	5.4		5.9
RF VSWR	LO = +13 dBm	Ratio		2:1	
LO frequency range	LO > RF	GHz	5.4		5.9
LO power range		dBm	+13		+16
LO VSWR	LO = +13 dBm	Ratio		1.5:1	
Bias	+15 VDC	mA		150	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF-to-IF conversion gain	LO = +13 dBm	dB		20	
Single-sideband noise figure at 25°C	LO = +13 dBm	dB		6	6.7
Channel to channel	LO = +13 dBm				
Amplitude tracking		dB	-0.5		+0.5
Phase tracking		Degrees	-5		+5
Isolation		dB	30		
Image rejection	LO < RF	dB	20		
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	See IF options below		20		200
IF VSWR	LO = +13 dBm	Ratio		2:1	

OUTLINE DRAWING



** Is optional.
NOTE: All dimensions shown in brackets [ ] are in millimeters.

MAXIMUM RATINGS

Specification temperature ...... +25°C
Operating temperature .... -54 to +85°C
Storage temperature................ -65 to +125°C

Available IF frequency options:
IR3A5459LR6 *
A: 20 to 40 MHz
B: 40 to 80 MHz
C: 100 to 200 MHz

NOTE: Test data supplied at 25°C; conversion loss, amplitude and phase tracking, channel-to-channel isolation, LO-to-RF isolation and image rejection.

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6.4 TO 7.4 GHz DIRECT MICROWAVE DIGITAL I/Q MODULATOR

MODEL: SYS6474N01R (Carrier Driven)

FEATURES

- **RF bandwidth.............................. 6.4 to 7.4 GHz**
- **I/Q bandwidth.............................. DC to 100 MHz**
- **Phase accuracy .... ±2°**
- **Sideband harmonics.................. -30 dBc**
- **Carrier rejection.......................... -30 dBc**
- **BIT output .... TTL**

APPLICATION

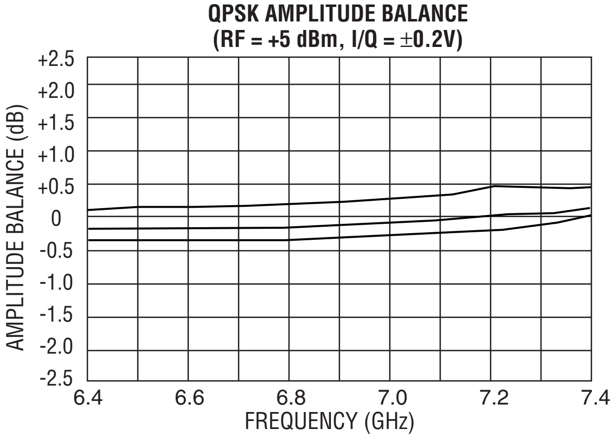
This linear IF digital modulator accepts ±0.2 volts input I/Q Gaussian shaped pulses and provides QAM RF with the same envelope shape. Less channel bandwidth is required when the modulation is shaped and the I/Q phase states are also differentially coded (DQPSK). Input and output buffer amplifiers are provided to ensure that generator and load mismatches do not affect quadrature accuracy and the resulting symbol error rate.

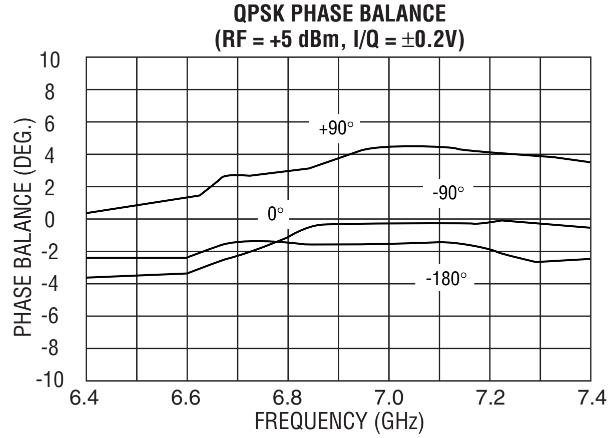
ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
Frequency range (carrier)		GHz	6.4		7.4
RF VSWR	50 ohm reference	Ratio		1.5:1	
RF power range		dBm	0	+5	+10
I/Q frequency range (modulation)		MHz	DC		100
I/Q volt range		Volts	-0.2		+0.2
I/Q VSWR	50 ohm reference	Ratio		1.5:1	
DC current	+12 V	mA		150	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain (relative to I/Q inputs)	RF = +5 dBm	dB	0	3	
RF phase accuracy (static)	I/Q = ±0.2 V, 50 ohms	Degrees		±2	±5
Sideband rejection (f_o - f_m)	Relative	dBc		25	
Carrier rejection (f_o)	to	dBc	25	30	
Second-harmonic rejection ($f_o \pm 2f_m$)	desired	dBc	30	35	
Third-harmonic rejection ($f_o \pm 3f_m$)	sideband	dBc	30	40	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF frequency (modulated carrier)			6.4		7.4
RF VSWR	RF input: +5 dBm	Ratio		1.2:1	
RF power (I/Q = +0.2 volts)	RF input: +5 dBm	dBm		+10	
BIT voltage (I/Q off, I/Q on)	RF input: +5 dBm	Volts	.30	Off/On	3

CARRIER DRIVEN TYPICAL TEST DATA

SYS6474N01R





DYNAMIC MODULATION SPECTRUM (RF level = +6 dBm, I/Q level = +4 dBm total, = 20 MHz)

Frequency (GHz)	f_0 + IF (I.L., dB) Note 1	f_0 - IF (dBc)	f_0 (dBc)	f_0 - 2 IF (dBc)	f_0 + 2 IF (dBc)	f_0 - 3 IF (dBc)	f_0 + 3 IF (dBc)
6	7.2	30.1	31	53	33	44	49
6.4	6.9	23.5	32	62	35	42	44
6.8	6	27.8	30	64	34	46	51
7.2	4.7	32	29	57	38	42	52
7.6	3.9	23.5	31	58	36	38	40
8	3	20.5	31	55	37	33	38

MAXIMUM RATINGS

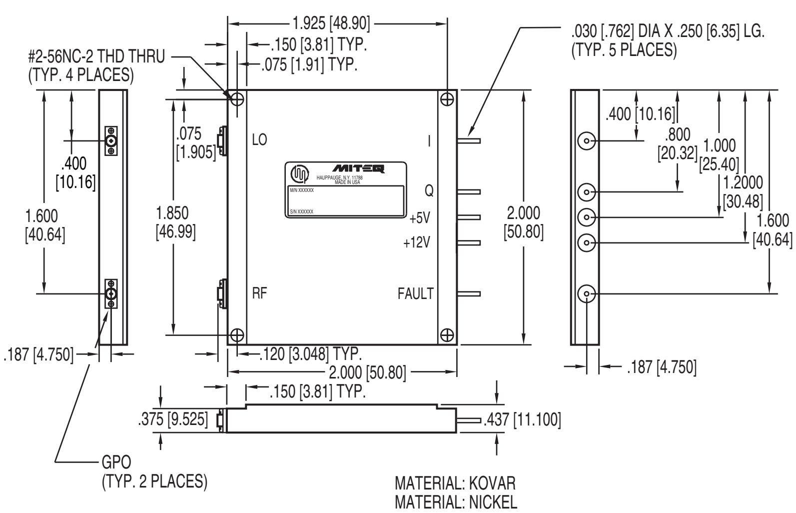
Specification temperature .... +25°C
Operating temperature .... -54 to +85°C
Storage temperature .... -65 to +125°C

GENERAL NOTE

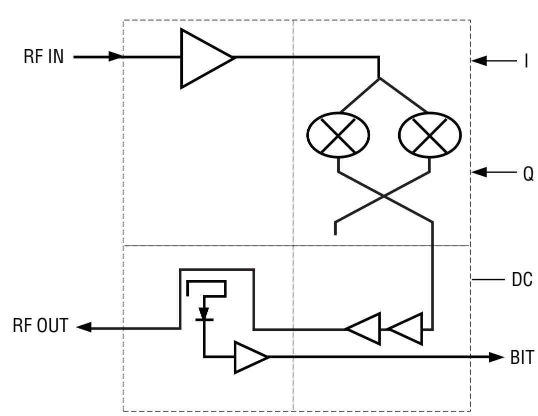
1. Insertion loss relative to 0 dBm IF input. All other outputs, including f_0, are relative to the desired upper (f_0 + f_m) output.

Voltage Ø	0°	90°	180°	270°
I (Volts)	+0.2	+0.2	-0.2	-0.2
Q (Volts)	+0.2	-0.2	-0.2	+0.2

OUTLINE DRAWING



BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

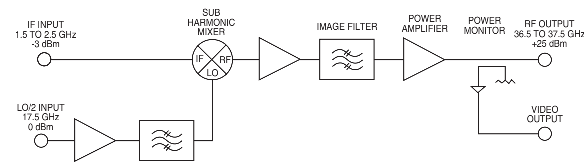
CUSTOM PRODUCTS

INTEGRATED UPCONVERTER AND POWER AMPLIFIER

MODEL: SYSTX3638

FEATURES

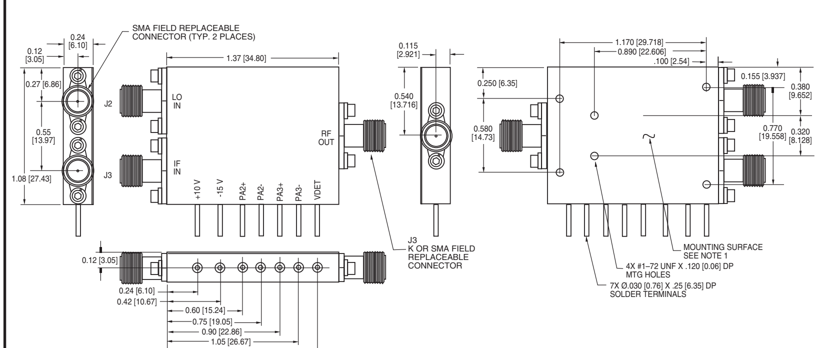
- IF frequency range .... 1.5 to 2.5 GHz
- RF frequency range.......... 36.5 to 37.5 GHz
- Fundamental leakage .... -50 dBm
- Packaging.......................... Hermetically sealed



ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
IF frequency range		GHz	1.5		2.5
IF VSWR	50 ohm reference	Ratio		2:1	
Input power		dBm		0	
LO frequency range		GHz		17.5	
LO power range		dBm	-2		+2
LO VSWR	50 ohm reference	Ratio		2:1	
V+ bias voltage (Note 1)	@ 1,600 mA max.			+10	
V- bias voltage (Note 1)	@ 60 mA max.		-9		-15
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain		dB	30		
Fundamental LO leakage	@ RF output	dBm			-50
Leakage LO X2	@ RF output	dBm			0
Leakage (with Option 1)		dBm			-60
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF frequency range		GHz	36.5		37.5
RF VSWR	50 ohm reference	Ratio		2:1	

OUTLINE DRAWING



NOTE: Plus external bias board.
All dimensions shown in brackets [ ] are in millimeters.

MAXIMUM RATINGS

Specification temperature .... +25°C
Operating temperature .... -55 to +65°C
Storage temperature........................ -65 to +95°C

Options
BPF 1. External RF bandpass filter

NOTE 1: Supplied with external voltage regulator board, with bias protection circuit.) PA2 + and -, and PA3 + and - voltages are derived from the +10, and -12 V supplies on the regulator board.
Option 2: Supplied with all regulators internal to device–no external board.

NOTE: Test data supplied at 25°C; output power, output frequency spectrum, bias current and voltage.

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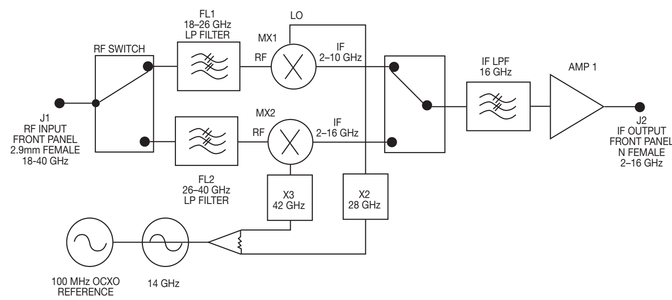
18 TO 40 GHz BLOCK DOWNCONVERTER

MODEL: SYS1840A24R

FEATURES

- **RF frequency range............ 18 to 40 GHz**
- **Low phase noise internal LOs**
- **Local/remote band switch**
- **Ruggedized case**
- **Input power .... 120 VAC**
- **Stable ovenized frequency reference**



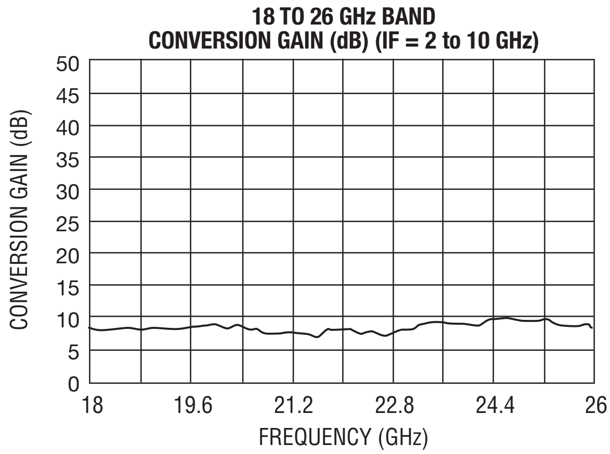
The SYS1840A24R block downconverter is a dual-band downconverter with frequency coverage from 18 to 40 GHz. It is suitable for use as a frequency extension for lower frequency test equipment. The internally generated LO source features high frequency stability, and very low phase-noise. The unit also features a built-in AC power supply, and electronic band switch that can be controlled by a front-panel switch, or via a remote control signal. An optional RF amplifier is available for low noise applications.

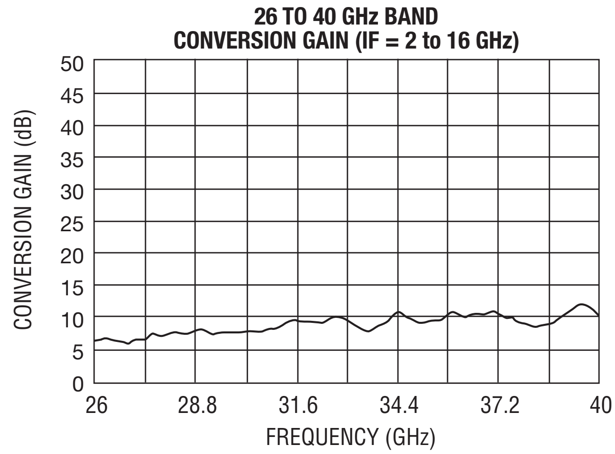
ELECTRICAL SPECIFICATIONS

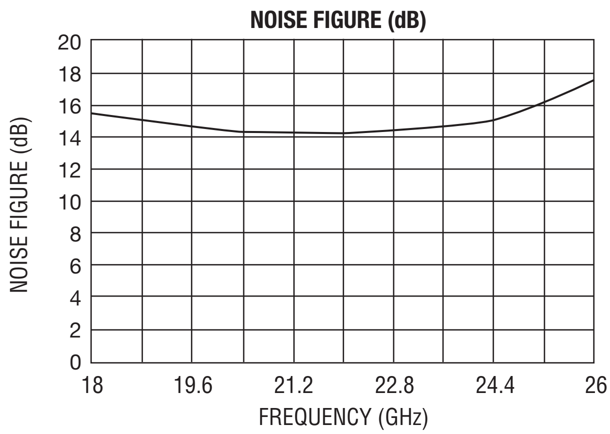
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range	Band 1	GHz	18		26
	Band 2	GHz	26		40
RF VSWR		Ratio		2.5:1	
Band select	TTL pulse	Volts	0		5
LO VSWR		Ratio		2.5:1	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain	Band 1	dB	3	6	9
	Band 2	dB	3	8	13
Single sideband noise figure					22
Fundamental LO leakage at IF	14 GHz	dBm			-52
Image rejection		dB		35	15
Output power at 1 dB compression		dBm	3		
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	Band 1	GHz	2		10
	Band 2	GHz	2		16
Band indicator	Band 2 = High	Volts	0		5
IF VSWR	TTL	Ratio		2.5:1	

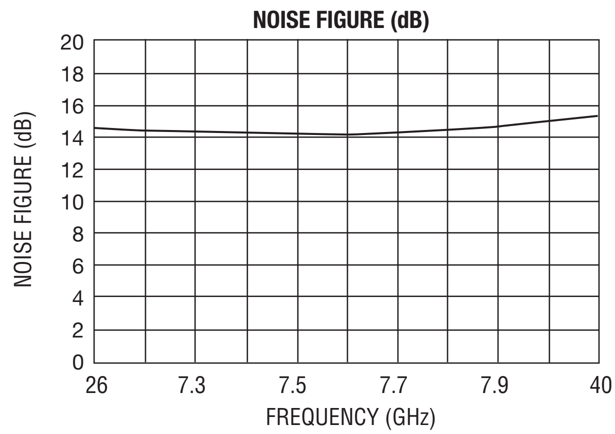
Revised: 03/21/11

SYS1840A24R TYPICAL TEST DATA









MAXIMUM RATINGS

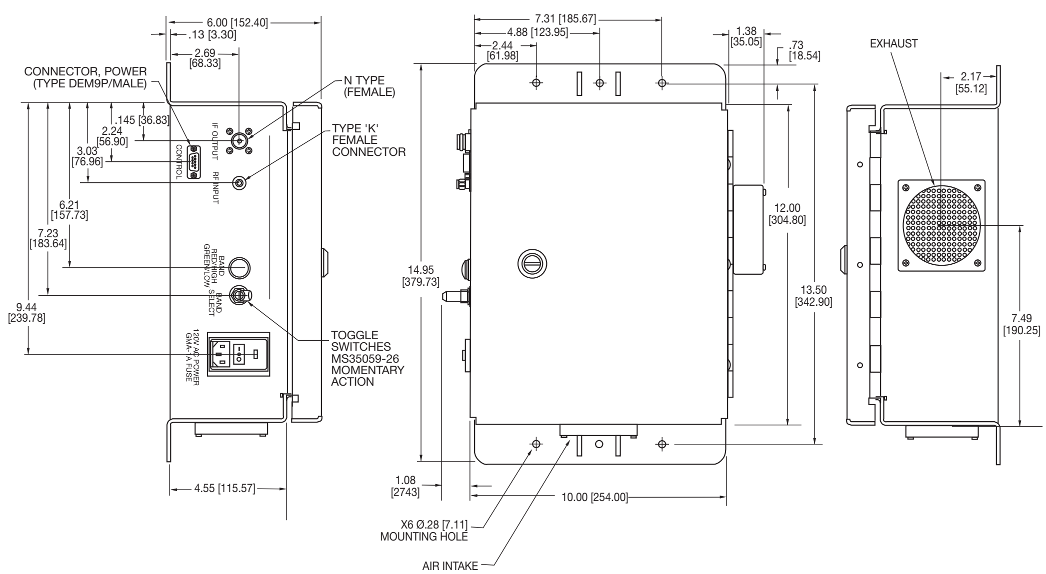
Specifications taken at .... +25°C

Operating temperature....................... -20 to +50°C

Storage temperature .... -55 to +95°C

NOTE: Test data supplied at 25°C. Conversion gain, leakage, noise figure, image rejection, compression point.

OUTLINE DRAWING



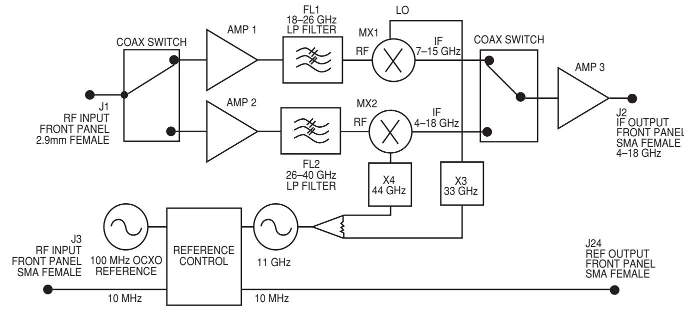
NOTE: All dimensions shown in brackets [ ] are in millimeters.

LOW-NOISE BLOCK DOWNCONVERTER

MODEL: SYS1840N01R

FEATURES

- **RF frequency range.......... 18 to 40 GHz**
- **Conversion gain .... 30 dB**
- **Noise figure....................... 7 dB**



The SYS1840N01R low-noise, block downconverter is a dual-band downconverter with frequency coverage from 18 to 40 GHz. It is suitable for use as a receiver front-end for wideband systems, or frequency extension modules. An internally generated LO source can be commanded to lock to an internal 10 MHz reference, or to an external 10 MHz reference for phase coherent applications. The internal 10 MHz reference is low phase-noise, ovenized design and is available at a reference output connector. The RF band is selected via an external TTL input, for remote control applications. The unit is integrated into a 3” x 4” x 5.3” cube for ease of integration into an equipment chassis or antenna feed.

ELECTRICAL SPECIFICATIONS

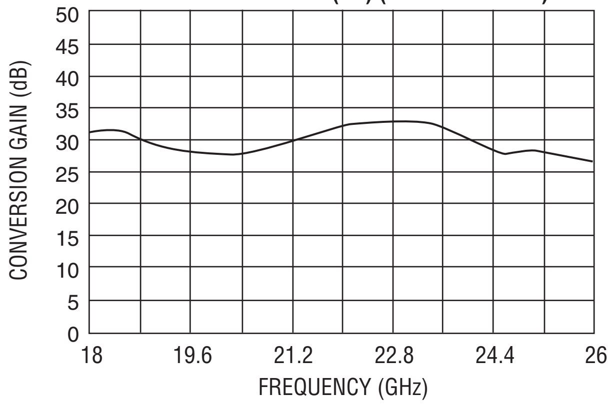
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range	Band 1 Band 2	GHz GHz	18 26		26 40
RF VSWR		Ratio		2.5:1	
Reference select	External	Volts		5	
Reference input	10 MHz	dBm	+3		+11
Power supply voltages	+15 at .8A max. -15 at .06A max. +9 at .8A max.	Volts Volts Volts	14.5 -16 8.7		15.5 -9 10
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain		dB	24		36
Single-sideband noise figure at 25°C		dB		4	7
Fundamental LO leakage at IF	11 GHz	dBm		-55	-50
Image rejection		dB	40		
Output power at 1 dB compression		dBm	+5	+7	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	Band 1 Band 2	GHz GHz	7 4		15 18
IF VSWR		Ratio		2.0	
Reference output	10 MHz	dBm		+4	

CUSTOM PRODUCTS

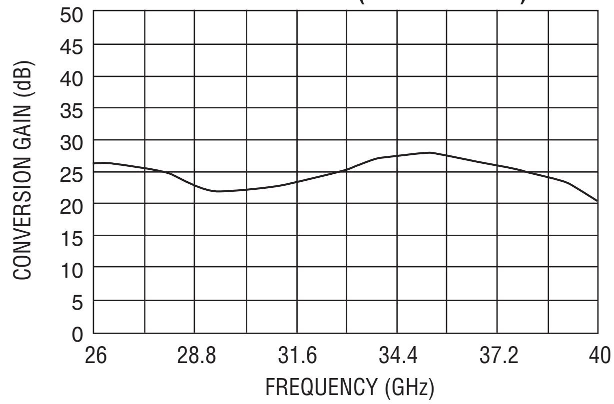
Revised: 05/05/11

SYS1840N01R TYPICAL TEST DATA

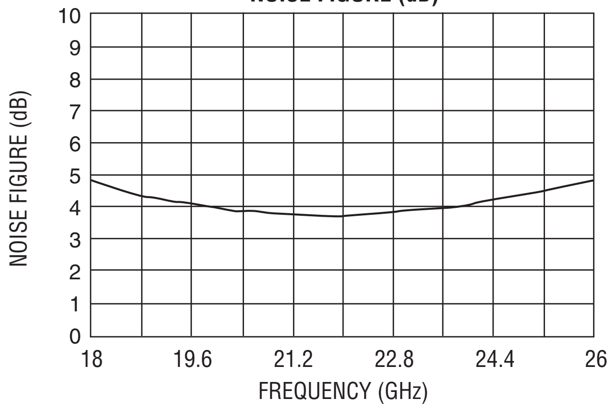
18 26 GHz Band
CONVERSION GAIN (dB) (IF = 7 to 15 GHz)



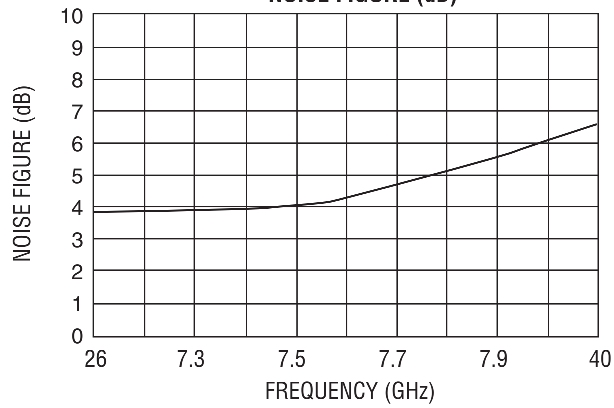
26 40 GHz Band
CONVERSION GAIN (IF = 4 to 18 GHz)



NOISE FIGURE (dB)



NOISE FIGURE (dB)

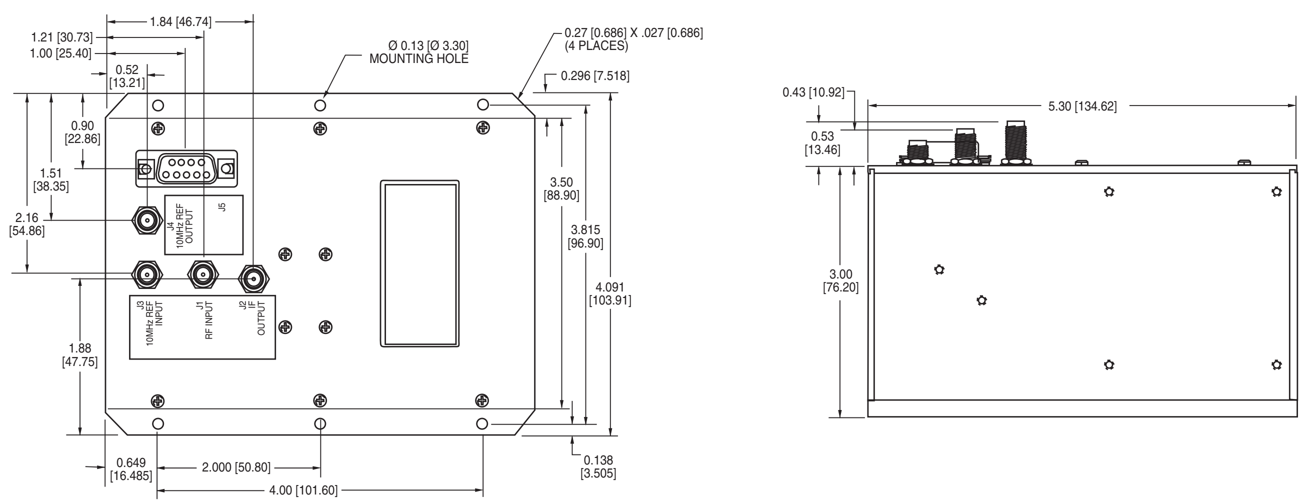


MAXIMUM RATINGS

Specification temperature .... +25°C
Operating temperature .... -40 to +70°C*
Storage temperature .... -65 to +125°C
*Unit to be mounted with thermal heatsink attached to base plate.

NOTE: Test data supplied at 25°C; conversion gain, noise figure, image rejection and compression point.

OUTLINE DRAWING



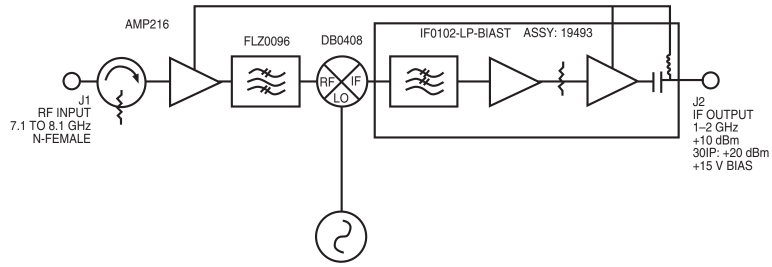
NOTE: All dimensions shown in brackets [ ] are in millimeters.

X-BAND LOW-NOISE BLOCK CONVERTER

MODEL: LNB-7181-02

FEATURES

- Low noise figure
- Weatherproof design
- Bias provided through IF ports
- Low phase noise internal oscillator
- Internal crystal reference



The LNB-7181-02 is a weatherproof block converter offering very low noise figure and low phase noise. The output Bias-T allows bias voltage to be provided via the IF port cable. The unit is suitable for use at an antenna feed to preserve signal integrity.

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	7.1		8.1
RF VSWR (RF = -10 dBm, LO = +13 dBm)		Ratio			1.2:1
LO frequency range		GHz		6.1	
LO phase noise	1 kHz 10 kHz 100 kHz 1 MHz	dBc/Hz dBc/Hz dBc/Hz dBc/Hz			-70 -90 -110 -120
LO accuracy	-30 to +60°C	kHz			±100
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion loss (IF = 100 MHz, LO = +13 dBm)		dB	40		
Single sideband noise figure at 25°C at 60°C		dB dB			1.3 2
Image rejection		dB	40		
RF-to-IF isolation		dB		80	
Output power at 1 dB compression		dBm	+10		
Output two-tone third order intercept point		dBm	+23		
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		GHz	1		2
IF VSWR		Ratio			1.5:1

LNB-7181-02 TYPICAL TEST DATA

VSWR

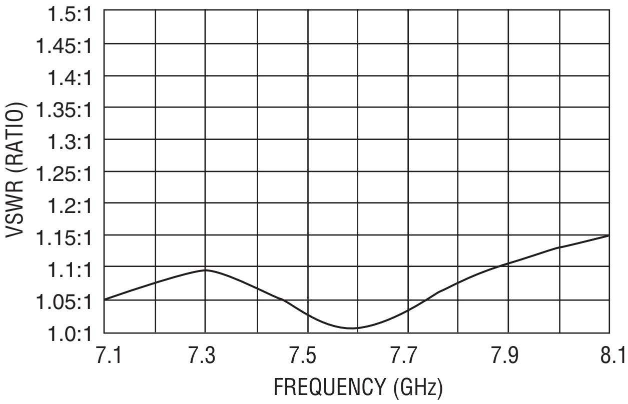
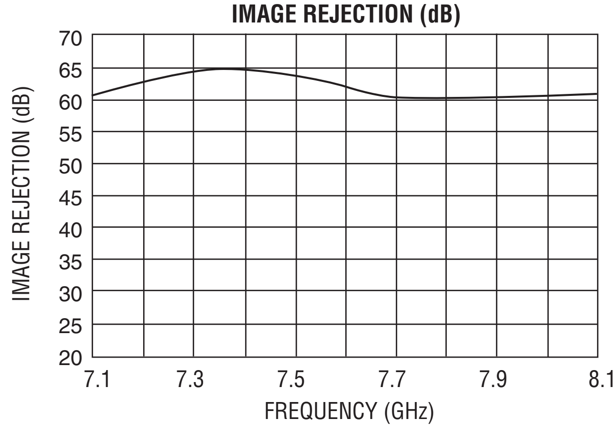
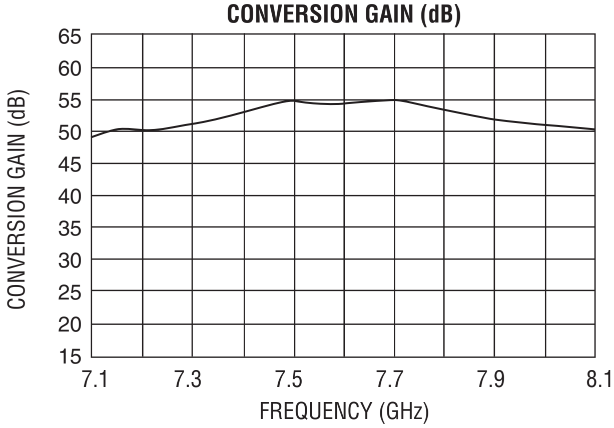


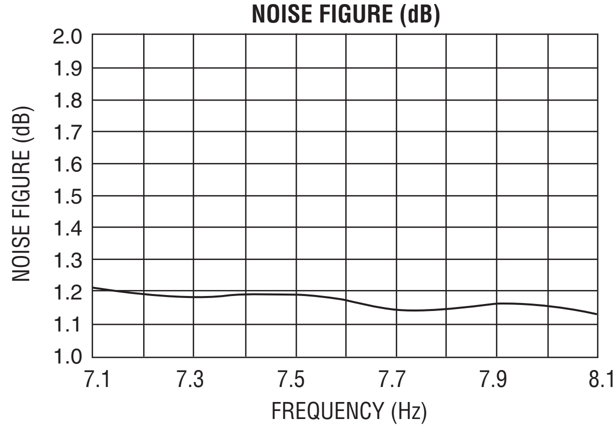
IMAGE REJECTION (dB)



CONVERSION GAIN (dB)



NOISE FIGURE (dB)



MAXIMUM RATINGS

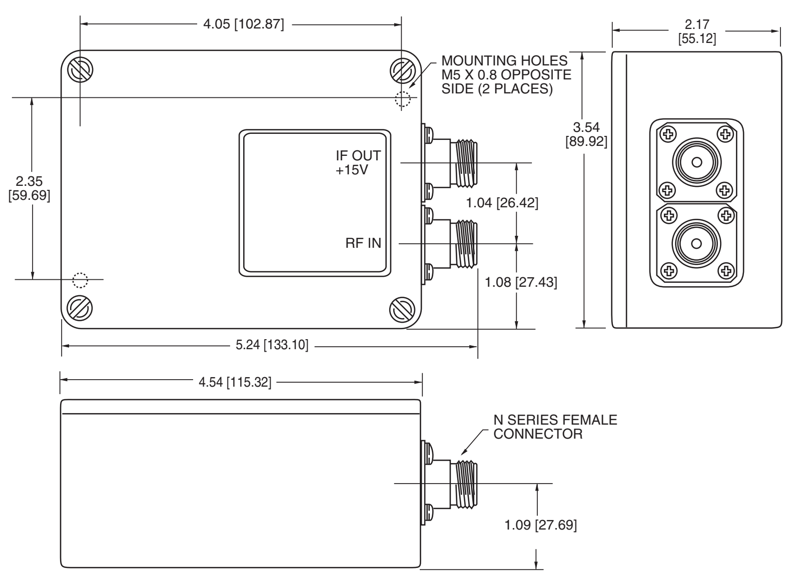
Specification temperature .... +25°C
Operating temperature .... -30 to +60°C
Storage temperature .... -65 to +125°C

AVAILABLE OPTION

1. Other RF/LO frequency ranges.

NOTE: Test data supplied at 25°C; conversion gain, noise figure, image rejection and compression point.

OUTLINE DRAWING



NOTE: All dimensions shown in brackets [ ] are in millimeters.

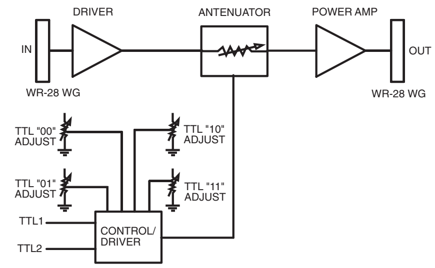
CUSTOM PRODUCTS

34 TO 36 GHz SWITCHED POWER AMPLIFIER ASSEMBLY

MODEL: SYS3436N01R

FEATURES

- **High output level .... +27 dBm**
- **Wide adjustment range.......... 10 dB**
- **Field adjustable**



The SYS3436N01R is a TTL-controlled switched power amplifier assembly with four preset output power states. All four output states are field adjustable over a 10 dB range. Applications include TWT driver and test instrumentation.

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
Frequency range		GHz	34		36
Input level		dBm	+4		+7
Input/output VSWR	50 ohm reference	Ratio		2:1	
V+ bias current	@ +9 to +16 V	A		2	
V- bias current	@ -9 to -16 V	mA		150	
Output power (factory preset)	Control="00"	dBm		+17	
	Control="01"	dBm		+20	
	Control="10"	dBm		+22	
	Control="11"	dBm		+27	
Output power adjustment range (all states)		dB	10		
Switching speed		usec.			20

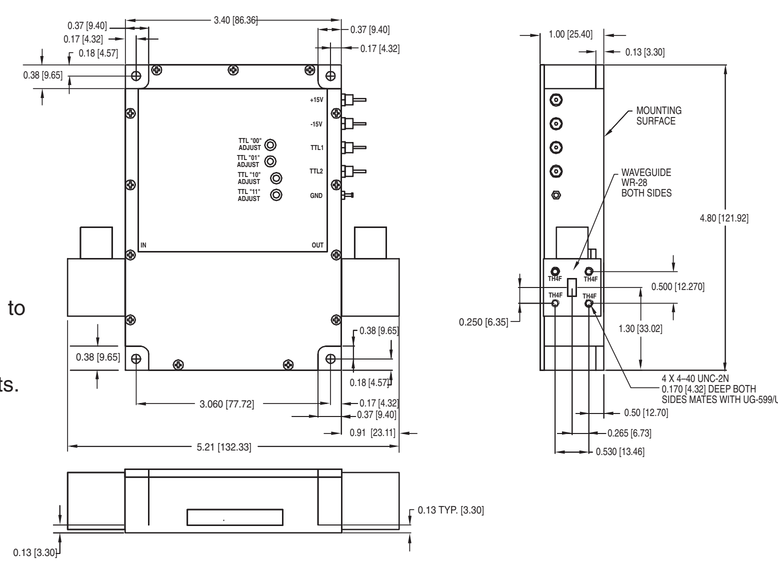
MAXIMUM RATINGS

Specification temperature .... +25°C
Operating temperature .... -35 to +65°C
Storage temperature .... -40 to +95°C

OUTLINE DRAWING

NOTES:

1. Unit's mounting surface shall be attached to a heatsink capable of dissipating the devices power consumption without exceeding the operating temperature limits.
2. Mass 413 grams typical.
3. All dimensions shown in brackets [ ] are in millimeters.



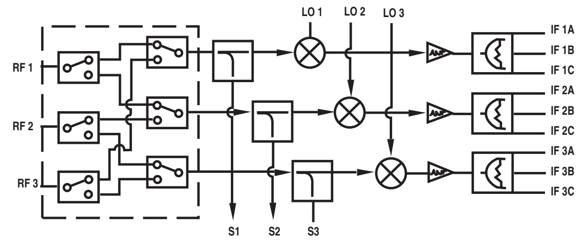
CUSTOM PRODUCTS

2 TO 4 GHz LOW-NOISE MIXER PREAMPLIFIER WITH SELECTABLE INPUTS

MODEL: SYS0204N01R

FEATURES

- **Low system noise figure ...... 11 dB typical**
- **Fast switching .... 50 nsec typical**
- **Image rejection .... 20 dB typical**
- **Cross path isolation.............. 60 dB typical**
- **Fast blanking function.......... 10 nsec typical**



The SYS0204N01R is an integrated low-noise converter with internal image filtering and a 3P2T RF input selection switch. All three RF inputs and IF outputs are simultaneously active and feature 60 dB of isolation between the paths. The switch activates within 50 microseconds and also features the ability to perform a blanking function at speeds as fast as 10 nanoseconds. RF signal test ports are provided for sampling the input signal to each mixer. Hermetic sealing is available for high reliability applications. Please contact MITEQ for more information.

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	2		4
RF VSWR	50 ohm reference	Ratio		1.8:1	
V+ bias current	@ +15 V	mA			450
LO frequency range		GHz	2.065		4.110
LO power range		dBm	+8		+11
LO VSWR				1.8:1	
Switch control	-5 VDC	mA			0.01
	+0.9 VDC	mA			60
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
RF/IF path gain		dB	5.25		6.75
Image rejection		dB		20	
Single sideband noise figure		dB		11	
RF coupled test port gain		dB		-12	
Cross path isolation		dB		60	
Path switching time		nsec		50	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		MHz	55		110
IF VSWR		Ratio		1.25:1	

MAXIMUM RATINGS

Specification temperature .... +25°C
Operating temperature .... 0 to 50°C
Storage temperature .... -40 to +71°C

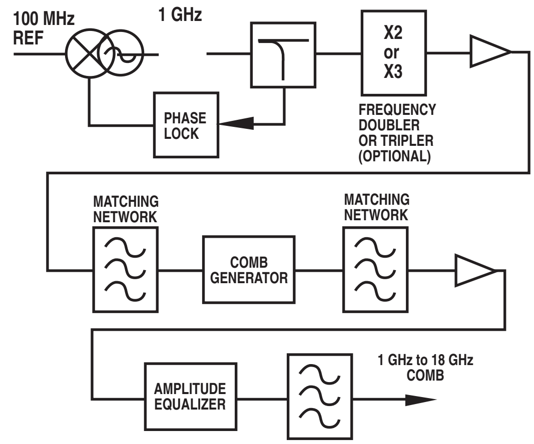
NOTE: Test data supplied at 25°C;
RF/IF path gain, image rejection and noise figure.

1 TO 18 GHz COMB GENERATOR FREQUENCY MULTIPLIER

MODELS: SYS0118N01R, SYS0218N01R AND SYS0318N01R

FEATURES

- **Low frequency input................ 100 MHz**
- **Flat output spectrum .... ±10 dB typical**
- **High spurious-free dynamic range.......................... 50 dB typical**
- **Single DC supply...................... +12 VDC**



MITEQ has developed a line of comb generator multiplier products. Three models are available: SYS0118N01R, SYS0218N01R and SYS0318N01R, with output comb spacing of 1 GHz, 2 GHz and 3 GHz, respectively. Each model accepts a 100 MHz input signal and produces a synchronous spectral comb. A fully integrated architecture is used to implement an internal phase-locked oscillator technique prior to exciting the multiplier, resulting in high spectral purity and low amplitude variation without degradation of the output signal-to-noise ratio. Options available are a switched filter output for individual tone selection, higher output power and lower overall phase noise. Please contact MITEQ for more information.

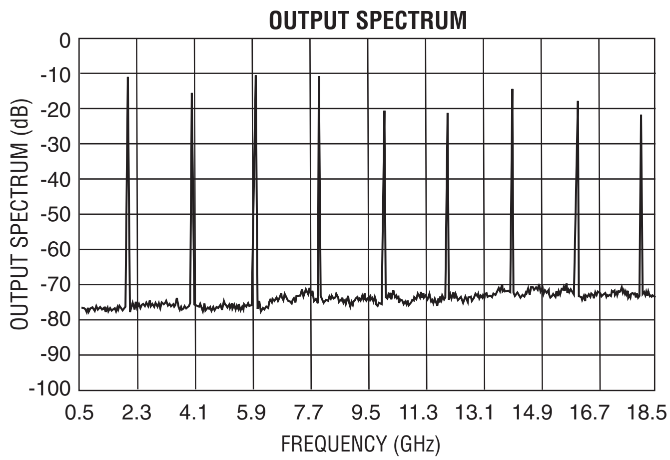
ELECTRICAL SPECIFICATIONS

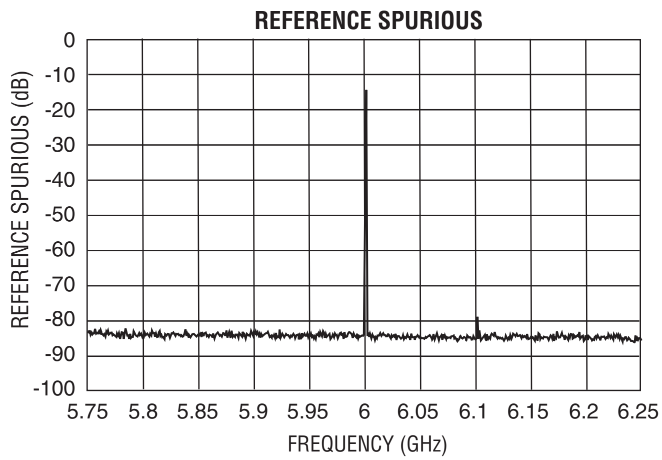
INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		MHz		100	
RF power range		dBm		0	
RF VSWR	50 ohm reference	Ratio		1.5:1	
V+ bias current	@ +9 to +16 V	mA			400

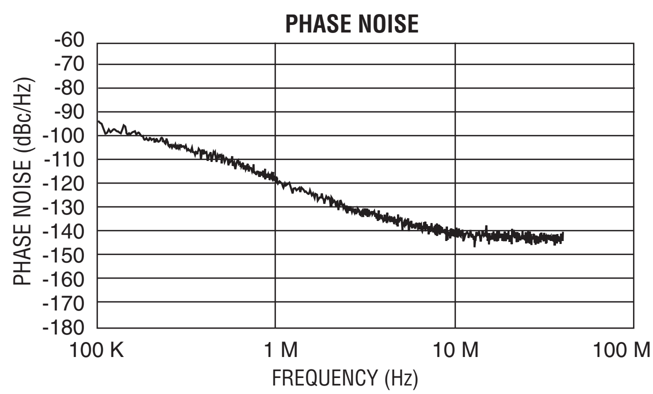
TRANSFER CHARACTERISTICS	CONDITION	UNITS	MIN.	TYP.	MAX.
Phase noise	SYS0118N01R				
100 Hz		dBc/Hz		-98	
1 kHz		dBc/Hz		-105	
10 kHz		dBc/Hz		-107	
100 kHz		dBc/Hz		-112	
1 MHz		dBc/Hz		-133	
10 MHz		dBc/Hz		-150	
(Note: Phase noise for other models varies, please contact MITEQ.)					
Spurious		dBc		-50	

OUTPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range	SYS0118N01R	GHz	1		18
	SYS0218N01R	GHz	2		18
	SYS0318N01R	GHz	3		18
RF power (1 GHz tone)		dBm	0		-10
RF VSWR	50 ohm reference	Ratio		1.5:1	
Spectral flatness		dB		±10	

SYS0218N01R TYPICAL TEST DATA



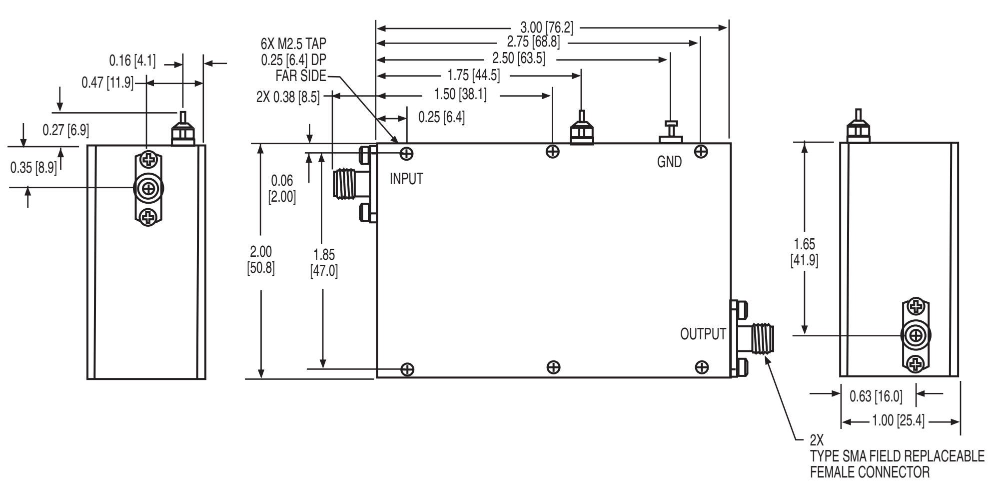




MAXIMUM RATINGS
Specification temperature .... +25°C
Operating temperature .... -40 to +70°C
Storage temperature .... -55 to +85°C

NOTE: Test data supplied at 25°C; per output spectrum data.

OUTLINE DRAWING



NOTE: All dimensions shown in brackets [ ] are in millimeters.

0.5 TO 18 GHz BROADBAND CONVERTER

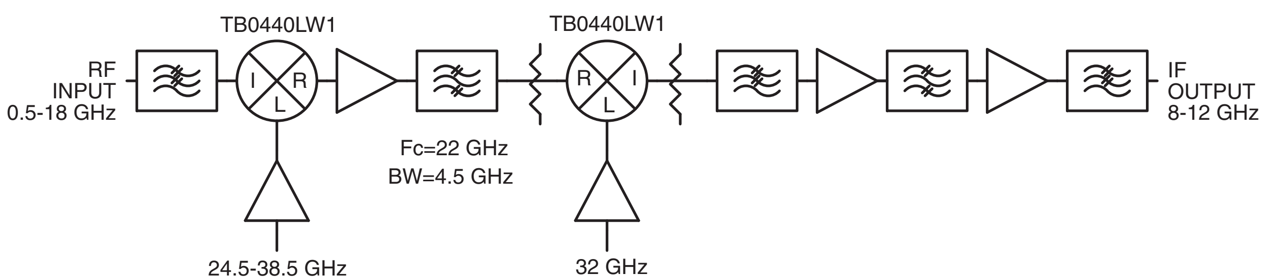
MODEL: SYS0518N01R

FEATURES

- **Dual conversion architecture for high spur rejection**
- **LO or RF-to-IF isolation .... 70 dB**
- **Image rejection .... 70 dB**
- **Conversion gain .... 20 dB**

The SYS0518N01R is a dual conversion receiver capable of translating any 4 GHz instantaneous bandwidth in the 0.5 to 18 GHz RF input range to an IF center frequency of 6 GHz. By using a high side LO and MITEQ's broadband TB0440LW1 mixer for the first conversion, it allows image frequencies to be easily filtered without the use of a tracking filter architecture, and allows for high image suppression not achievable from an image rejection mixer. The unit also offers high image rejection and RF-to-IF and LO-to-IF isolation of 70 dB.

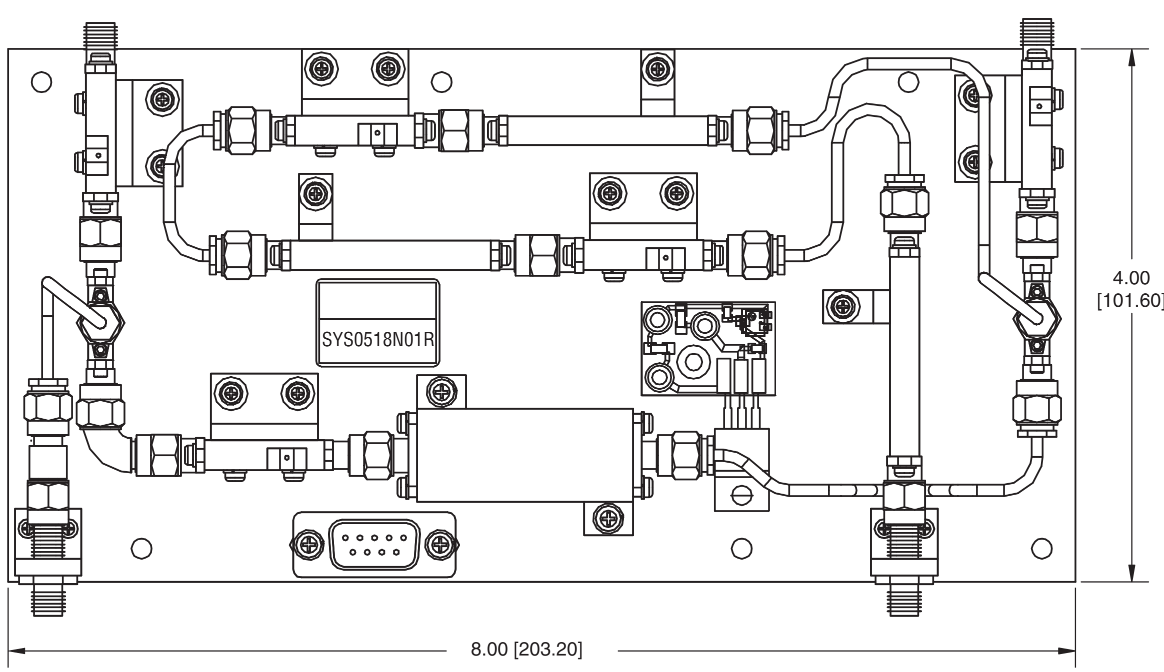
BLOCK DIAGRAM



MAXIMUM RATINGS

Operating temperature .... -20 to +60°C
Storage temperature .... -40 to +95°C

OUTLINE DRAWING



NOTE: All dimensions shown in brackets [ ] are in millimeters.

THREE-CHANNEL X-BAND MONOPULSE RADAR RECEIVER

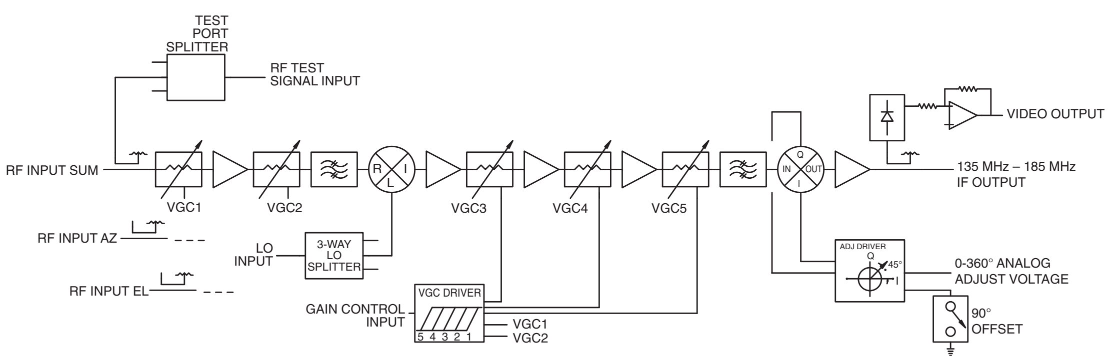
MODEL: SYS9.0N01R

FEATURES

- **RF input frequency .... 9.31 GHz ±30 MHz**
- **Conversion gain .... 83 dB**
- **Gain control range .... 80 dB**
- **Noise figure.................................. 7 dB**
- **Input compression point .... +10 dBm**
- **Front-panel phase and amplitude adjust for each channel**
- **BIT circuits for fault-detection**
- **Rugged packaging to withstand high vibration and temperature range**
- **High reliability screening**

The SYS9.0N01R is an integrated three-channel monopulse radar receiver front-end for use in receiving signal for a tracking radar system. The channel boasts an 80 dB gain control range to provide tracking over long distances. Internal phase adjusting circuits allow each channel to be phase matched in the system via front panel control. The unit has built-in test circuits to verify mixer diode performance and to test injection RF signals. Both detected log video, and linear IF outputs are provided. Internal LO and test port injection splitters are provided with phase matched performance. The units are screened under high vibration and thermal cycling for high reliability.

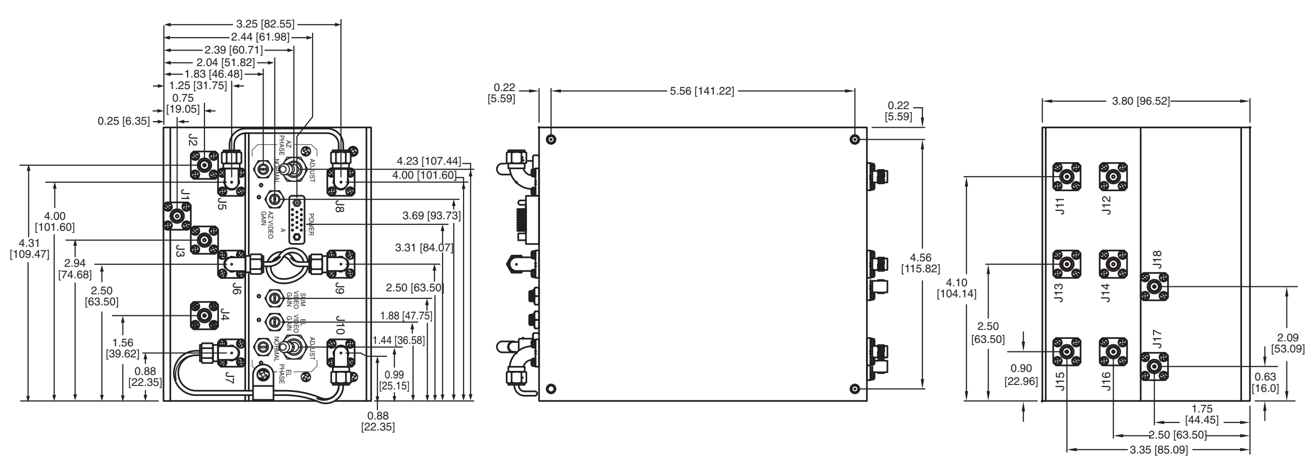
BLOCK DIAGRAM



MAXIMUM RATINGS

Operating temperature .... -40 to +65°C
Storage temperature .... -62 to +71°C

OUTLINE DRAWING



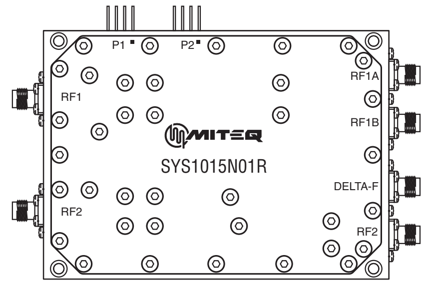
NOTE: All dimensions shown in brackets [ ] are in millimeters.

DUAL-CHANNEL SIGNAL PROCESSOR ASSEMBLY

MODEL: SYS1015N01R

FEATURES

- Two medium power amplified channels
- Integrated mixer to measure difference frequency
- Integrated prescaler to measure absolute frequency using a low frequency DSP
- Integrated power control for output leveling

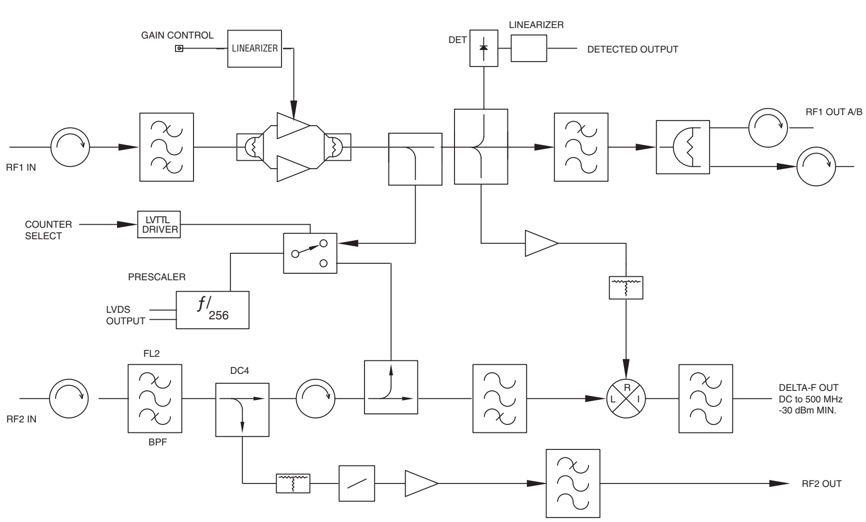


The SYS1015N01R is an integrated dual-channel signal processor for use in processing LOs in a microwave system. Integral gain control, power detector, mixer, and prescaler are used to control signal output power and monitor frequencies using lower frequency DSP technology. The unit is constructed for higher volume applications with surface mounted printed circuit boards designed for automated assembly.

ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range		GHz	10		15
RF VSWR	50 ohm reference	Ratio			2:1
V+ bias current	@ +15 V			600	
V- bias current	@ -15 V			50	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion gain		dB		5	
Power control range		dB		10	
Spurious/harmonic output level		dBc			-70
Minimum output capability		dBm		+13	
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range		GHz	DC		0.5
IF VSWR		Ratio		2:1	

BLOCK DIAGRAM



MAXIMUM RATINGS

Specification temperature ...... +25°C
Operating temperature............ 0 to 50°C
Storage temperature .... -20 to +65°C

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INTEGRATED DUAL-CHANNEL BLOCK CONVERTER

MODEL: SYS0216N01R

FEATURES

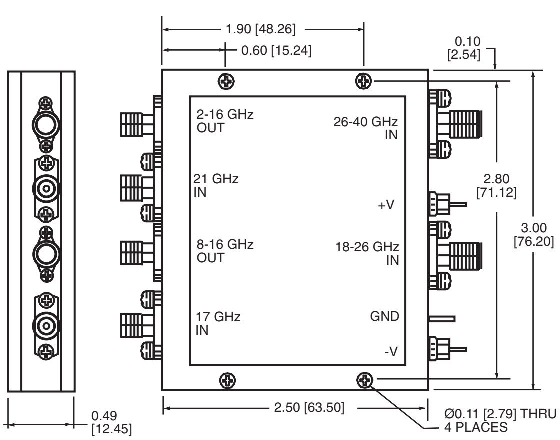
- **18–40 GHz frequency coverage**
  integrated aluminum housing

The SYS0216N01R is an integrated dual-channel millimeter-wave block converter with internal filtering and LO multipliers. The unit is used to convert signals in the range of 18–40 GHz down to 2–16 GHz. The unit will also function as an upconverter. Internal LO filtering significantly reduces fundamental LO leakage. High side LO and RF filtering provides full band image rejection of 20 dB typical. The unit is integrated in a channelized aluminum housing for small size and high spurious isolation. An optional mounting plate with low-noise RF amplifiers is available to function as a low noise block converter.

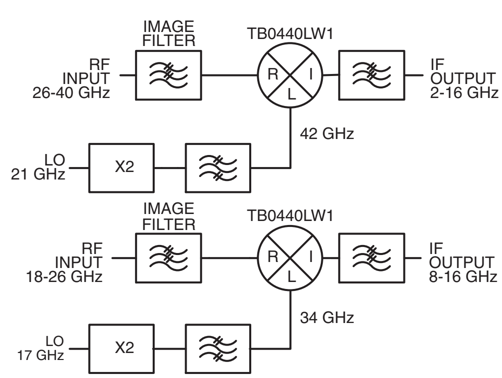
ELECTRICAL SPECIFICATIONS

INPUT PARAMETERS	CONDITION	UNITS	MIN.	TYP.	MAX.
RF frequency range	Band 1 Band 2	GHz GHz	18 26		26 40
RF VSWR	50 ohm reference	Ratio		2.8:1	
V+ bias current	@ +9 to +16 V	mA		450	
V- bias current	@ -9 to +16 V	mA		30	
LO frequency range	Band 1 Band 2	GHz GHz		17 21	
LO power range		dBm	+10	+12	+14
LO VSWR				2.5:1	
TRANSFER CHARACTERISTICS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
Conversion loss		dB		14	18
Image rejection		dB	12	20	
Input 1 dB compression point		dBm		+5	
Input third-order intercept point		dBm		+15	
Fundamental LO leakage at IF port	17 and 21 GHz	dBm		-85	-75
LO leakage at RF port	34 and 42 GHz	dBm		-30	-20
OUTPUT PARAMETERS	**CONDITION**	**UNITS**	**MIN.**	**TYP.**	**MAX.**
IF frequency range	Band 1 Band 2	GHz GHz	8 2		16 16
IF VSWR		Ratio		2:1	

OUTLINE DRAWING



BLOCK DIAGRAM



NOTE: All dimensions shown in brackets [ ] are in millimeters.

SYS0216N01R TYPICAL TEST DATA

RF VSWR BAND 1 AND 2

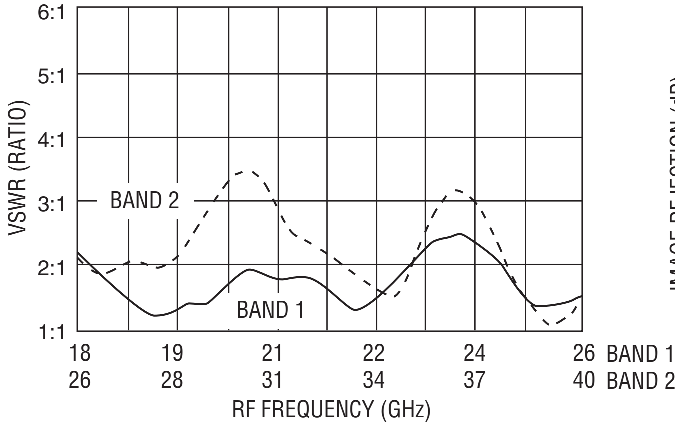
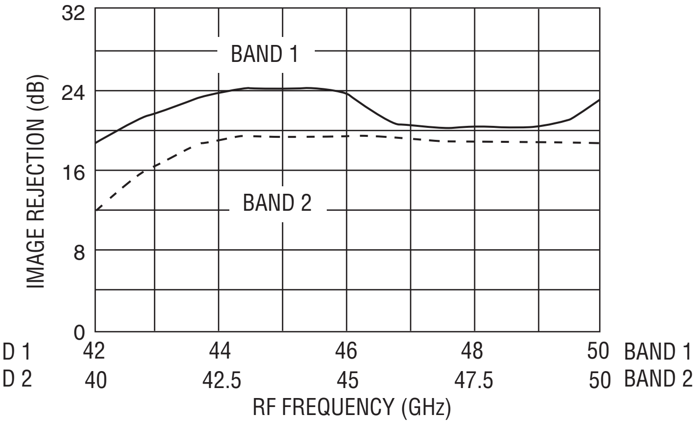
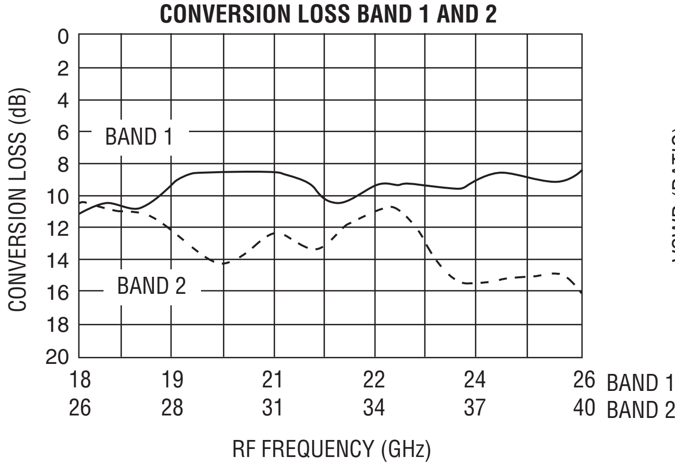


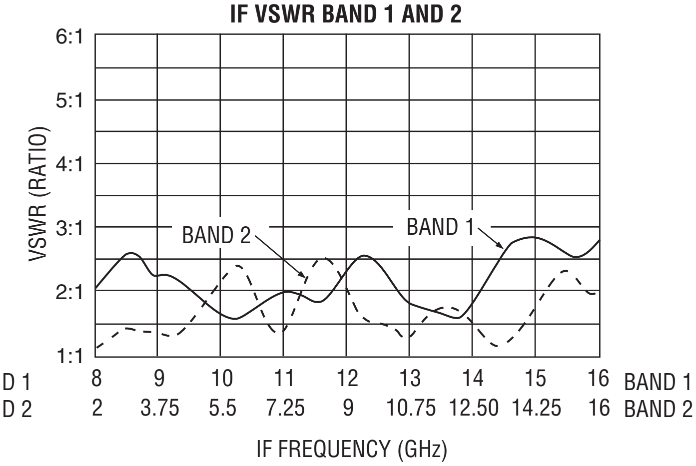
IMAGE REJECTION BAND 1 AND 2



CONVERSION LOSS BAND 1 AND 2



IF VSWR BAND 1 AND 2

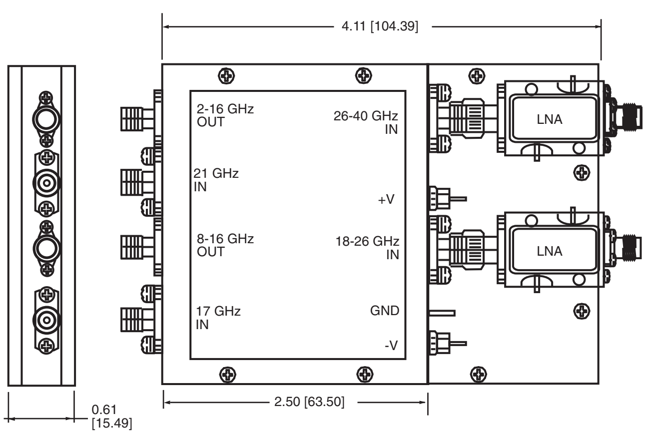


MAXIMUM RATINGS

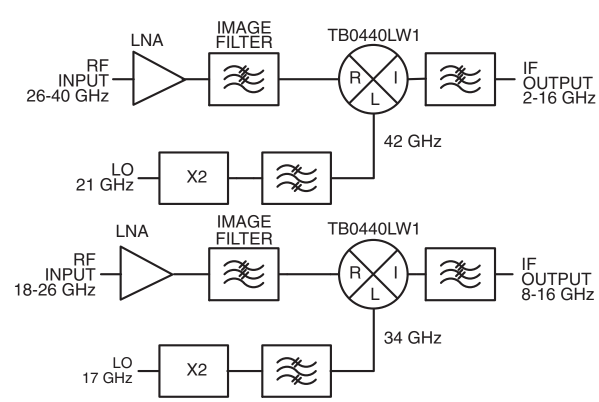
Specification temperature .... +25°C
Operating temperature .... -40 to +65°C
Storage temperature........................ -65 to +95°C

NOTE: Test data supplied at 25°C;
conversion gain, image rejection, noise figure
and output 1 dB compression point.

OPTIONAL LNB OUTLINE DRAWING*



OPTIONAL LNB BLOCK DIAGRAM*



* Contact MITEQ for LNB option ordering information and specifications.
NOTE: All dimensions shown in brackets [ ] are in millimeters.

CUSTOM PRODUCTS

Questions and Answers about...

MIXER SUBSYSTEMS

Q1: How does the Mixer Product Department define a mixer subsystem?

A1: Generally, the subsystem consists of one or more unique core mixer products from catalog sections 1 through 4, with added input or output components (such as amplifiers, filters, etc.) or simply phase and amplitude matched groups of the core mixer product with associated power dividers for LO, RF or IF.

Q2: What advantages do the subsystems offer the customer?

A2: Subsystems or multifunction components in general are designed to customer specifications. They offer the customer guaranteed input/output performance without worry about the ever-present interface problems between the individual system building blocks. By eliminating intermodule connections, the units offer smaller size and light weight alternatives to assembled connectorized or drop-in components. These multifunction modules utilize, in addition to the mixer capability, our low-noise amplifier technology and our high performance, small size frequency sources. In addition, limiters, switches, filters, couplers, etc., can be incorporated to satisfy the customer's requirements. Special multichannel assemblies can also be produced in gain and phase matched modules.

Q3: How are the mixer subsystems grouped in this portion of the catalog?

A3: Generally, by market and complexity, because the final cost factor influences how the integration of the subsystem is accomplished. For example, all communication subsystems are intended to lower the overall cost consistent with meeting minimum standards of performance, whereas the radar and military subsystems tend to emphasize small size with screened components and state-of-the-art performance at fair prices.

Q3.1: How does MITEQ define millimeter-wave products?

A3.1: The millimeter-wave frequency band is generally accepted to mean from 30 to 300 GHz (1 mm to 0.1 mm wavelengths). For our purpose, however, in this section of the catalog, most products cover up to 50 GHz range. Furthermore, these products tend to utilize the MITEQ core technical advantages of: low-noise RF amplifiers, widest input and output bandwidth mixers, phase-stable oscillators and multipliers.

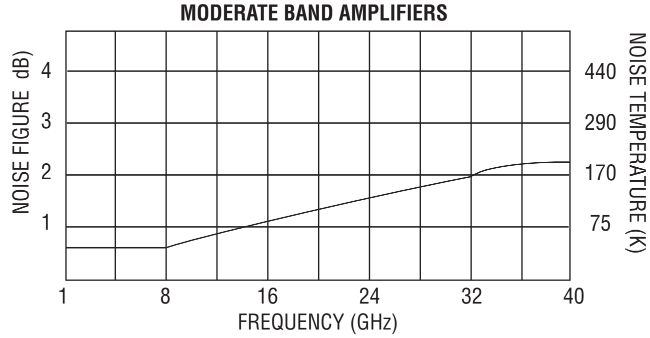
Q3.2: What are the core advantages of Special Mixer Department's millimeter-wave products?

A3.2: MITEQ offers the widest input/output bandwidth millimeter-wave up- and downconverters. The most popular triple-balanced unit is TB0440LW1 with an RF and LO bandwidth of 4 to 40 GHz and an IF bandwidth of 0.5 to 20 GHz. Even-harmonic units are also available with less IF bandwidth, but require an LO of only 2 to 20 GHz to downconvert the 4 to 40 GHz, with only 1 to 2 dB higher loss than fundamental mixing. Another key advantage of our department's mixer products is the capacity to integrate the low-noise amplifiers of other MITEQ departments into a single-interface compensated unit.

The principal market for these products is low-noise block up- and downconverters that allow the user to perform operations at high frequencies utilizing existing lower frequency equipment.

The following plot shows the current capability of MITEQ's low-noise amplifiers in this frequency range.

LNA AMPLIFIERS
NOISE FIGURE VS. FREQUENCY
MODERATE BAND AMPLIFIERS



Q3.3: What factors influence the choice of high or low side LO placement in wideband millimeter-wave block converters?

A3.3: Generally, one tries to eliminate extra LO x RF mixing products that combine the fundamental RF with harmonics of the LO. These products are highest in level and are also independent of the RF power. For example, the 3LO-RF and 2LO-RF are typically -10 and -25 dBc, respectively, below the desired LO-RF output. In general, for wide bandwidth applications, the LO harmonic mixing products are much more likely to occur with low side mixing. For other applications, where LO x RF spurious products are not an issue, one may want to avoid the spectral inversion of low side mixing by placing the LO above the RF. High side mixing is also frequently employed to eliminate the image response of a wideband receiver without tracking filters. However, another fixed frequency mixer and LO is necessary to make this "dual conversion" technique function. The first double-sideband mixer, IF output is chosen high enough in frequency to produce an image band that falls outside the input RF range. For example, with a 2 to 18 GHz RF input and tracking 24 to 40 GHz LO, the IF is fixed at 22 GHz and the image (2LO - RF) is 46 to 62 GHz. A second mixer and LO would be required to downconvert the 22 GHz first IF to perhaps 1 GHz. Caution is necessary, of course, to reject the image response of the second mixer at 20 or 24 GHz, but this is easier with a fixed frequency relative to the problem of a multioctave input. The first DSB mixer for this application can be a MITEQ TB0440LW1.

Q3.4: How can undesired M x N (LO x RF) spurious products be minimized for a given application, assuming that "high side mixing" and LO power are not options?

A3.4: Triple-balanced mixers traditionally yield the lowest level spur products provided that the diode quads and circuit baluns are constructed to yield high interport isolation. Restricting the RF and IF operating bandwidths will also eliminate many spur products, provided that out-of-band signals are also filtered. The table below shows the maximum possible input RF, percentage bandwidth possible before certain low order products occur. Both fixed LO operations above or below the RF band are shown, each with an octave IF output bandwidth for comparison (reference = Microwave Journal - 1990)

MAXIMUM RF INPUT (PERCENTAGE BW) FOR "BLOCK DOWNCONVERTERS" TO AVOID CERTAIN M X N (LO X RF) SPURIOUS PRODUCTS (FOR CASE OF OCTAVE OUTPUT IF BANDWIDTH AND NO RF/IF BAND OVERLAP)

CONDITIONS	LO X 2RF	2LO X RF	2LO X 2RF	2LO X 3RF	3LO X 2RF	3LO X 3RF
LO > RF IF BW = 0.66 (octave)	0.20	0.40	0.40	0.15	0.40	0.43
LO < RF IF BW = 0.66 (octave)	0.40	0.20	0.40	0.40	0.15	0.43

One can see from the above table that progressively smaller RF bandwidths are required to completely avoid certain products. The maximum RF bandwidth is also restricted to no more than 40% for the specific case of octave IF bandwidth. This also avoids any overlapping of the input and output bandwidth.

Q3.5: How are the general principles of the previous questions and answers applied to a specific millimeter-wave example?

A3.5: Figure 1 illustrates several 26 to 40 GHz block downconverters, each for the 4 to 18 GHz output band. The spur tables associated with each LO configuration illustrate the advantages of "high side" LO mixing to avoid LO harmonic products. In addition, an octave output bandwidth mixing configuration is shown that utilizes the previous principles of reduced bandwidths to eliminate spurs. However, three separate LOs and preselectors are required. See the following page for Figure 1.

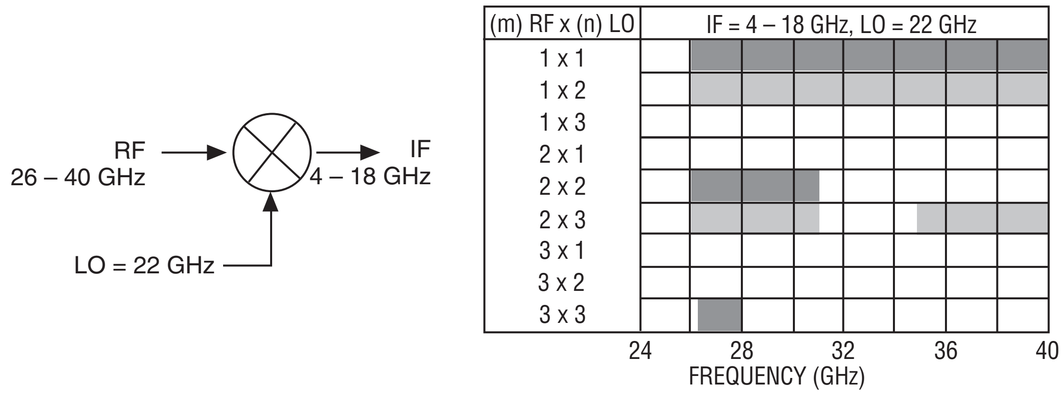
Spurious in-band responses for 26 to 40 GHz downconverter:

A. Block downconverter (LO < RF)

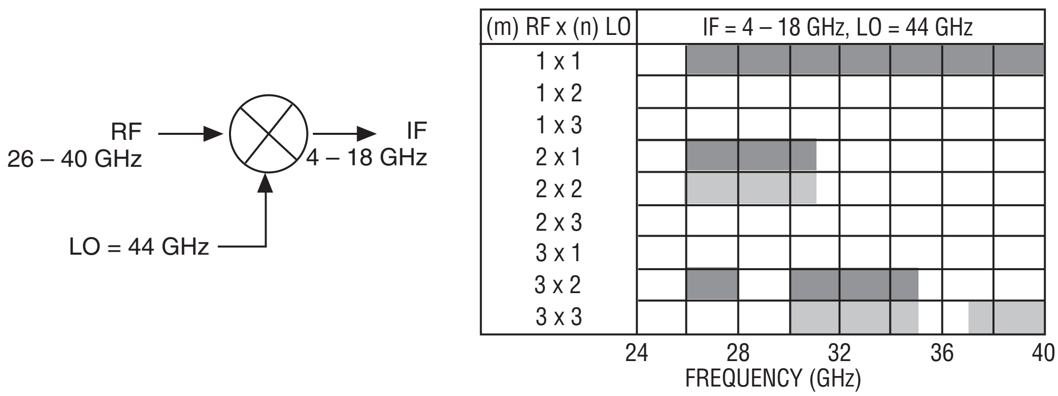
B. Block downconverter (LO > RF)

C. Multiple LOs with filters

A. INVERTING BLOCK DOWNCONVERTER LO < RF



B. NONINVERTING BLOCK DOWNCONVERTER LO > RF



C. THREE-BAND FILTERED BLOCK DOWNCONVERTER LO > RF

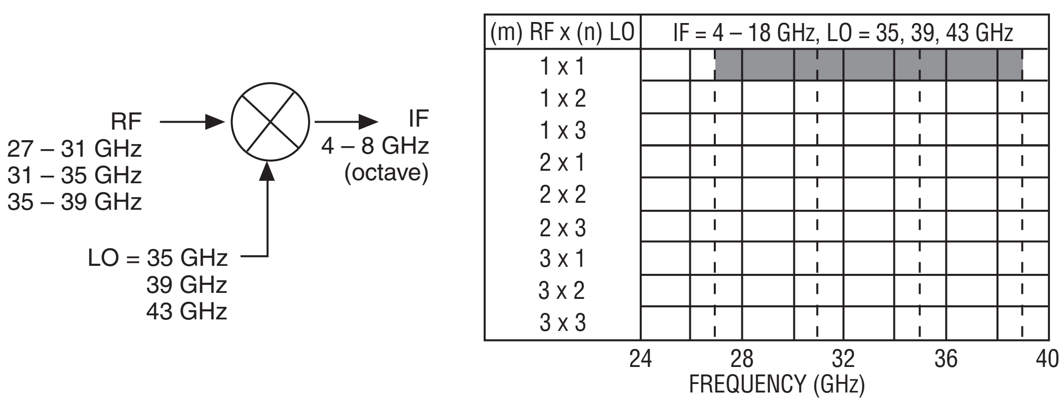


FIGURE 1

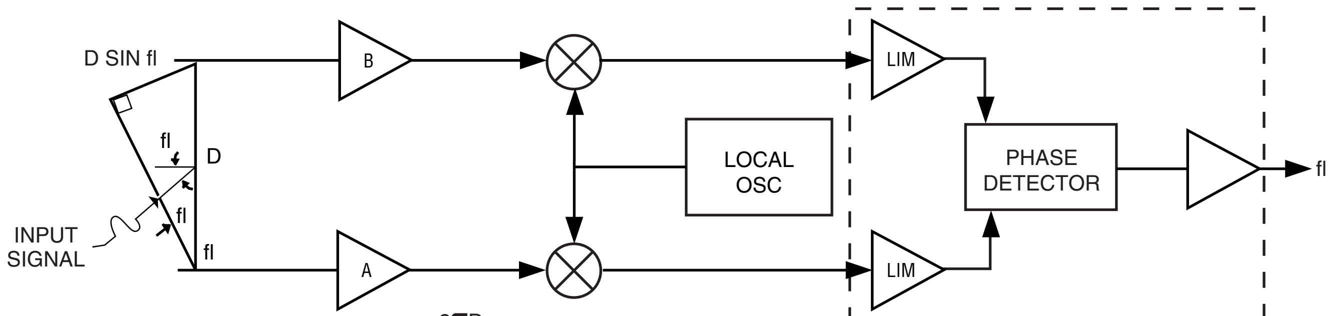
Q4: What are some examples of new mixer subsystems useful to the communication engineer?

A4: Sampling mixers (Model SRD0218LW4) are becoming more prevalent in compact receivers and phase-locked frequency sources because they do not require a high power microwave LO to downconvert the desired signal to a low IF frequency. I/Q sampling mixers can also be used for direct demodulation of biphase signals.

In addition, a new triple-balanced Schottky mixer allows direct multioctave block downconversion of the millimeter-wave 20 to 40 GHz band into an existing 0.5 to 20 GHz receiver. This is possible by using the TB0440LW1 mixer and a MITEQ-fixed frequency (+10 dBm) LO above or below the band of interest. This mixer is also useful for upconverting the 0.5 to 18 GHz band into a fixed Ku-band second converter, thus eliminating the image response without tunable filters.

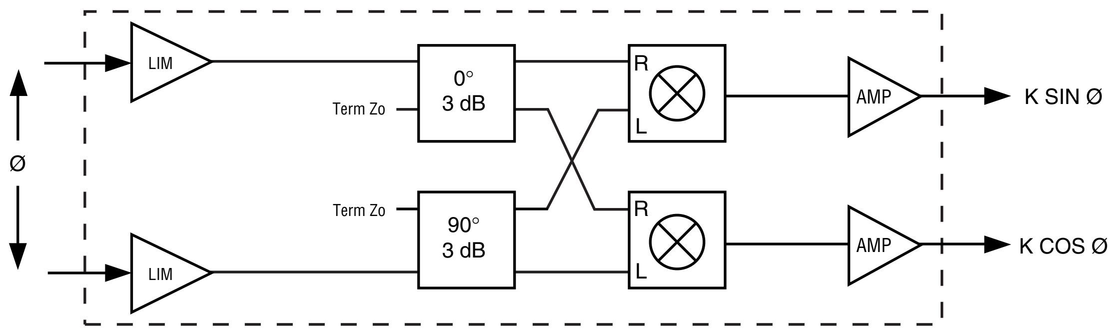
Q5: What are the basic principles of passive direction finding?

A5: The block diagram below shows a method of measuring the phase angle difference between signals reaching amplifiers A and B. All amplitude variations are removed by the IF limiters so the system is relatively insensitive to channel gain differences. A low DC offset double-balanced mixer is used to measure the phase difference, but since the mixer provides the same output voltage for two different phase angles, there is a 180 degree ambiguity in the measurement.



$$\text{PHASE DIFFERENCES} = \psi = \frac{-2\pi D}{\lambda} \text{ SIN } \varnothing$$

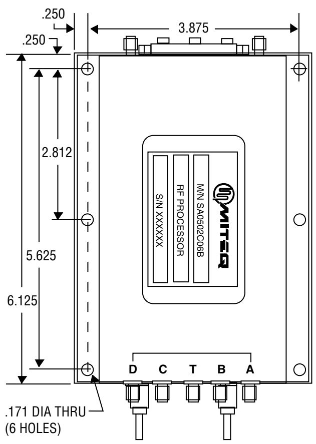
Alternately, one can use an I/Q phase correlator or demodulator to resolve the ambiguity. The I/Q outputs can be used to form a convenient polar display of a received angle. I/Q phase correlators are available at microwave and lower frequencies, although the accuracies are usually higher over narrow bandwidths below 1 GHz.

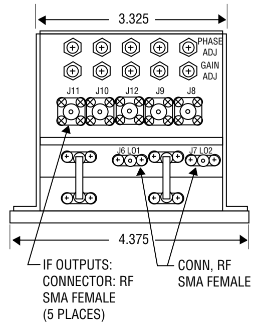


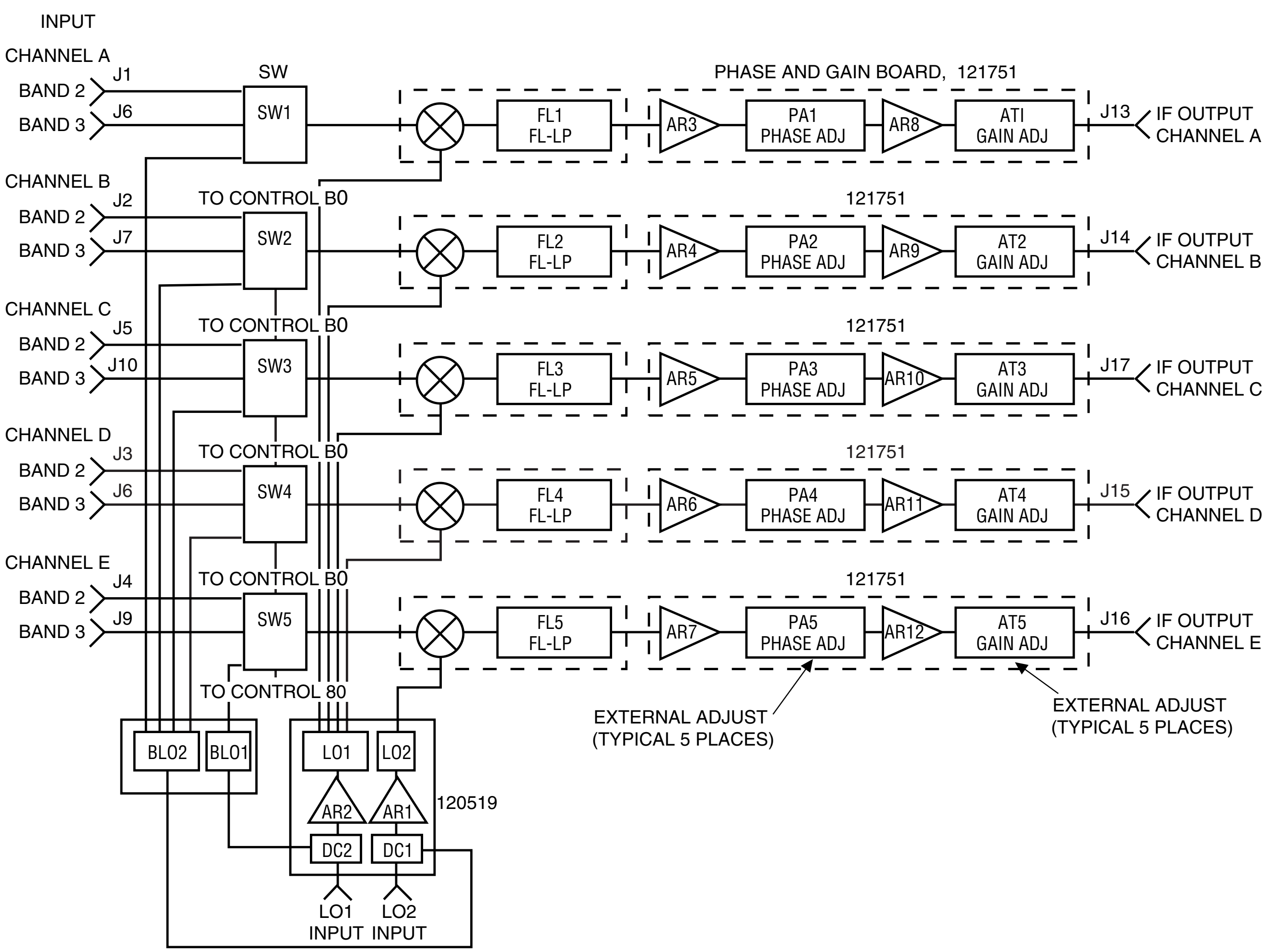
MITEQ DPD SERIES

MIXER SUBSYSTEMS (CONT.)

Actual DF systems use pairs of antennas in the horizontal plane (azimuth) and vertical (elevation) plane. In addition, a fifth channel is sometimes used to resolve angular ambiguities. Frequently the antenna bandwidths are less than the receivers, so that input switching is required. The receiving must also be protected from high input power. The block diagram below illustrates a MITEQ five-channel catalog direction finding subsystem less the I/Q phase detectors (see MITEQ Model DSS Series).

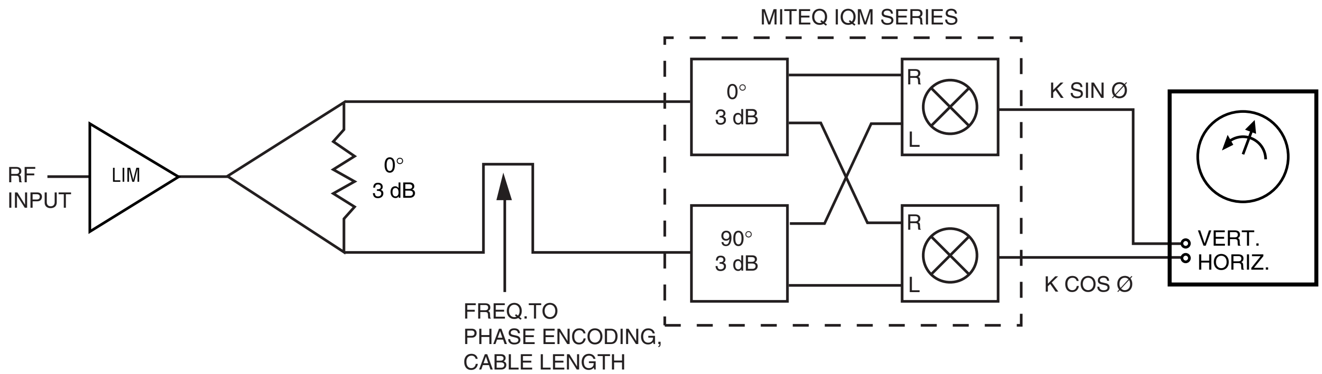






Q6: Can the basic direction finding receiver be used to also measure incoming frequency?

A6: Yes, by first encoding the received signal into two separate outputs that have a phase difference in direct proportion to their frequency:



A large cable length difference in the two splitter outputs will yield rapidly varying phase with frequency. If these outputs are applied to a two-channel DF system, the output phase difference, together with knowledge of the encoder cable lengths, can be used to determine input frequency. This is the basic principle of an instantaneous frequency discriminator (IFM). In actual practice, several frequency encoders are used with progressively greater frequency resolution, much in the same manner that one reads the dials of a gas or electric meter.

Q7: What advantages do sampling mixers offer relative to conventional mixers/LOs for ELINT (Electronic Intelligence Gathering) receiver designs?

A7: Basically, lower cost and power consumption, because the sampling mixer utilizes a UHF LO with internal pulse shaping from a step recovery diode to downconvert an RF at 1 to 20 times higher in frequency. The sampling mixer diodes only charge for a short instant, thus requiring low LO energy relative to the amplifier multiplier chain used to generate the LO power required for a conventional fundamental mixer. The sampling mixer, however, has a limit on the maximum IF bandwidth equal to one half the applied LO frequency (owing to the repetitive frequency response of this mixer). Sampling mixers can also be made in I/Q and image rejection configurations (see Q & A in phase detector section).

Q8: What is meant by electronic warfare (EW) components?

A8: These are component groups that are used in systems that identify and defeat the goals of ground and missile radar systems. A typical component pair might be an I/Q downconverting mixer and upconverting modulator that alters some amplitude or frequency property of a received radar pulse and then retransmits it to act as a decoy reflection. In addition, since EW systems must protect the host vehicle from many different frequency signals with quick reaction times, the operating subsystem bandwidths are wide (often 0.5 to 18 GHz). Airborne EW systems frequently employ small size multiple mixers with a common output or second-stage processing receiver.

Q9: What precautions are necessary when purchasing front-end mixer components for radar receivers?

A9: If the mixer could be subjected to high peak power from transmitter leakage, one must use an input pin diode limiter to ensure that no more than approximately 50 mW/diode or +23 dBm per quad average power. This limit is based upon an average thermal resistance of 160°C/watt for a diode quad mounted on a soft suspended circuit board and maximum diode junction temperature of 125°C with an ambient temperature of 85°C. A single diode limiter available on most MITEQ mixer/preamplifiers will provide protection against a 100 peak power 1 μs pulse and 1 watt average power.

Q10: What choice of front-end components will maximize the dynamic range of radar receivers?

A10: The benefits of low-noise MITEQ AFS or AMF RF preamplifiers are well known and obvious in detecting minimum signal levels. However, the maximum input signal level is often limited by the second-stage image rejection mixer's 1 dB compression level. A general rule of thumb for the 1 dB compression level of any Schottky barrier mixer is 5 dB less than the LO power. Therefore, if the maximum output power level of the RF preamplifier is +10 dBm, one would need at least a +15 dBm LO power mixer to avoid restricting the dynamic range. A four-channel radar receiver would then require a total of +21 dBm or more LO power. The additional cost and excess noise of the required LO amplifier will impose more design restrictions. As an alternative, a MESFET image rejection mixer generally has an RF 1 dB compression point equal to the LO power, therefore, in this case, the total LO power required is +16 dBm.

The MITEQ Model ARS0506L is an example of a high dynamic range four-channel front end including the LNAs MESFET IR mixers, IF amplifiers and matched filters. The noise figure is typically 4 dB, but, could also handle up to +5 dBm of input broadband RF noise jamming before overloading. The IF filters used in this phase and amplitude tracked front end have uniform group delay, thus ensuring that paired echoes are at least 40 dB below the main response.

MILLIMETER-WAVE BLOCK CONVERTERS

A unique method has been developed for extending the frequency of existing 20 GHz broadband systems to cover the entire 26 to 40 GHz Ka-band without the need of a tuned front-end architecture. The Models LNB-2640-40 and LNB-1826-30 low-noise block (LNB) converters are combined to accept inputs over the 18 to 40 GHz frequency range and block convert the full band into the 2 to 20 GHz range, as shown in Figure 1. All of the converters' filtering and LOs are internal, including a phase-locked LO source that can be locked to an external 10 MHz reference.

A 26 TO 40 GHz BLOCK FREQUENCY CONVERSION

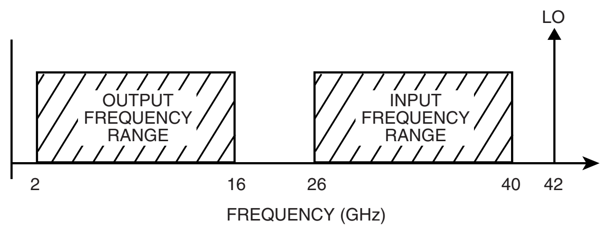


FIGURE 1

With the recent proliferation of both commercial and military applications throughout the Ka-band, a significant need has arisen for frequency conversion equipment to cover these now-popular ranges. Hardware requirements in support of these applications include not only the technology embedded in the systems, but also the supporting test equipment required to align, maintain and install the developed hardware.

With commercial applications such as 38 GHz point-to-point radios generating interest in high volume, low cost production, the obvious solution is to develop custom MMICs with millimeter-wave functions. This effort is already in place at many of the large foundry operations with 0.25 or 0.18 μm GaAs processes. Amplifier, mixer and multiplier blocks have been developed and currently are being integrated to offer complete application-specific transceiver modules at reasonable prices. Even military applications, such as 35 GHz monopulse seekers, can support enough volume to justify a custom MMIC development effort and are often satisfied by this route.

Although millimeter-wave MMIC technology has a strong foothold throughout the Ka-band, a host of requirements exist on the periphery of these volume applications that require more broad-based performance modules. These periphery applications increase the need for broadband block conversion systems, as shown in Figure 2.

BROADBAND BLOCK CONVERSION APPLICATIONS; (a) SPECTRUM ANALYZER AND (b) EW SYSTEM FREQUENCY EXTENSIONS

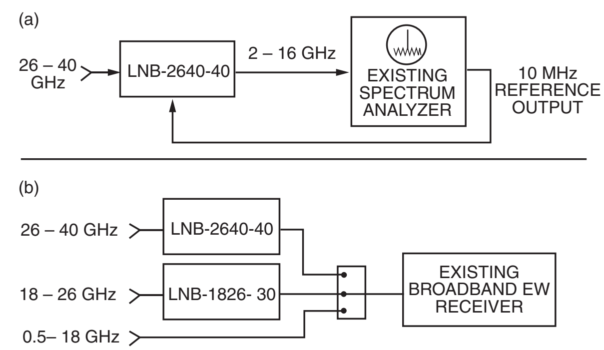


FIGURE 2

APPLICATIONS

Broadband block conversion is suitable for the test and measurement market, as well as for electronic warfare (EW) and electronic intelligence (ELINT) systems that are used to extend existing equipment operation into the low millimeter-wave bands. Spectrum analyzers operating from 10 kHz to 26 GHz have been on the market for several years. The analyzers are found in almost every microwave company in the world and, unfortunately, are obsolete to users who are shifting their focus to the higher frequency bands. An obvious solution to the reprocurement of such costly test equipment is to provide an adjunct subsystem that can easily extend the frequency of this existing equipment to cover the desired frequency bands.

Currently, most spectrum analyzer companies offer external harmonic mixers to extend the performance of their fundamental operating frequency range. However, these harmonic mixers have always been cumbersome to use, often requiring a swept LO to tune the desired signal into the narrow IF band of the mixer. A similar situation has also existed in broadband military systems. Presently, thousands of fielded electronic countermeasure and ELINT systems are operating over the 0.5 to 18 GHz band. Two choices are available to provide operation into Ka-band, including developing a full-up, tuned Ka-band system to cover the entire frequency range from 18 to 40 GHz, and adding an adjunct subsystem to the existing system to cover only the specific narrow bands above 18 GHz.

In both applications, the ideal solution would be to fold the entire upper band into the existing lower band to relieve the requirement for a tuned front end. This technique satisfies the requirement for minimizing additional hardware and the logistical impact of operating an additional system in the upper band. Using block conversion, all of the processing of the lower bands can be utilized throughout Ka-band with minimal modifications, which consist mainly of a simple frequency offset.

BLOCK CONVERSION

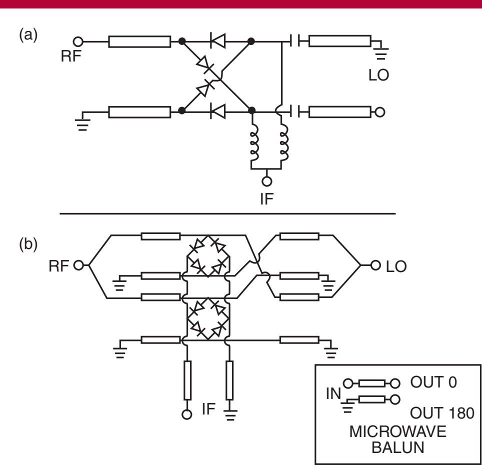
Folding an entire frequency range into another is also known as block frequency conversion or block conversion. The process requires only a fixed LO. More importantly, the process also requires a mixer with an IF coverage that matches the bandwidth of the RF band. This IF bandwidth limitation had been the longstanding reason why this approach was never utilized for Ka-band. A production-level mixer that could operate with an RF range from 18 to 40 GHz with an IF range to 20 GHz was all that was required.

MIXER ADVANCES

Mixers have long been available in lower bands that have IF coverage capable of performing broadband block conversions. A torroidal balun design utilizes a center-tapped transformer to extract the IF frequency, allowing it to have overlapping RF, LO and IF frequency ranges. However, this approach is only useful up to approximately 3 GHz before the performance of ferrite core baluns falls off and bifilar coupling structures become too small for practical use.

Above 2 GHz, the distributed or microstrip balun is utilized to perform the 180° transform required in a balanced design, as shown in Figure 3. The problem with this balun had been that the center tap did not exist to separate the IF from the RF or LO. As a result, diplexing and balance are needed to reject the RF or LO at the IF port in double-balanced designs. The problem with these

A (a) DOUBLE- AND (b) TRIPLE-BALANCED MIXER



double-balanced designs is that the upper frequency of the IF is dependent upon the quality of the diplexer. Because of the diplexer's filtering it is nearly impossible for the IF to be close in frequency to the RF or LO.

In the early 1980s, a solution to this problem was realized using what is commonly referred to as a double double-balanced or triple-balanced mixer design. In this approach, an additional microstrip balun and twice the number of diodes are incorporated to provide three mutually balanced ports on the mixer. With this approach, only balance is required to cancel one port's signal at the other. Therefore, overlapping frequencies and microwave IF coverage are no longer problems.

The triple-balanced mixer is now common up to 26 GHz with IF coverage available to 12 and sometimes 15 GHz. Irrespective of its near-commodity status, a microwave triple-balanced mixer is not a simple device. This design typically requires three orthogonal microstrip baluns with two diode quads soldered to all three, as shown in Figure 4. The limitation to extending this structure above 26 GHz has been typically associated with the parasitics of the complicated design and construction.

A TRIPLE-BALANCED MIXER ASSEMBLY

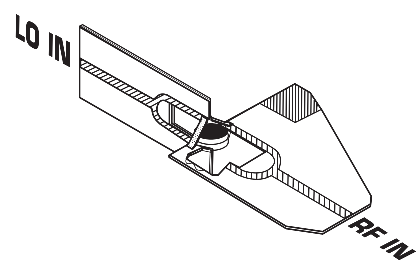


FIGURE 4

Higher frequency vesions of this same design have been developed over the last several years. In 1994, a breakthrough development resulted in the Model TB0440LW1 4 to 40 GHz triple-balanced mixer. Through reconstruction of the diode structure and tightly controlled manufacturing processes, this new mixer offers what was needed all along to accomplish Ka-band block frequency conversion.

BLOCK CONVERTER ASSEMBLY

A long with the development of a high-performance millimeter-wave mixer, other support products had to be developed to facilitate this LNB converter, as shown in Figure 5. As with most receivers, sensitivity is a critical electrical specification. To meet this demand, the JS series low-noise amplifiers (LNA) operating at frequencies up to 60 GHz were developed. Integrated into the front end of the LNB-2640-40 block converter is a 26 to 40 GHz LNA providing 24 dB of gain with a 2.5 dB noise figure.

Along with the LNA, a 42 GHz LO is required to facilitate the block conversion. A phase-locked ceramic resonator oscillator at 2.8 GHz, digitally locked to an external 10 MHz reference, is utilized. This frequency is then multiplied and filtered to 14 GHz by a single step-recovery diode multiplier, and finally multiplied again to 42 GHz by means of a balanced X3 Schottky diode multiplier. The multiplied ceramic resonator approach was chosen over a phase-locked dielectric resonator oscillator (DRO) at 14 GHz due to the cost impact of utilizing the DRO. Although some size is sacrificed, overall manufacturability and performance are not compromised.

THE LNB BLOCK DIAGRAM

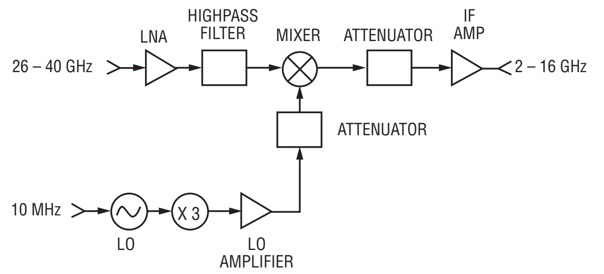


FIGURE 5

The final 42 GHz LO was chosen based upon the spurious signal performance of high side mixing, as well as the ease of filtering the image response and LO leakage. With high side mixing, much of the image suppression is inherent in the roll-off of the amplifier. However, a multisection waveguide bandpass filter is included to ensure consistency in performance from unit to unit. The IF band is unfiltered and boosted in gain by a four-stage LNA operating over the 0.5 to 20 GHz band. This amplifier not only drives the +10 dBm output power, but provides a good broadband match for interconnection to existing systems even through a long cable run.

SYSTEM-LEVEL PERFORMANCE

A performance summary of the LNB converter's individual components and the cumulative receiver is listed in Table 1. Table 2 lists some of the mixing spurious signals that can be expected from a -40 dBm input signal. In addition to the listed typical performance, a variety of standard options are offered, including a noninverting frequency conversion utilizing low side LO mixing, WR42 and WR28 waveguide inputs, an external LNA for remote feed applications, a low phase noise LO utilizing dual-loop vs. digitally locked technology and an internal crystal reference with frequency stability to ±1 PPM.

The applications realized with these millimeter-wave block frequency converters span a variety of customers and markets. Block conversion is a simple solution to a system option that was often overlooked due to technical concerns. As technology moves further into the millimeter-wave bands, block conversion is expected to become a more frequently sought-after solution to broadband system problems.

MIXING SPURIOUS SIGNALS (dBc)

RF HARMONICS (M) \ LO HARMONICS (N)	1	2	3	4	5
1	REF	26	12	33	22
2	46	52	46	56	47
3	58	63	59	70	63
4	80	>85	80	>85	>85
5	>85	>85	>85	>85	>85

TABLE 2

MILLIMETER WAVE TYPICAL PERFORMANCE

	LNA	FILTER	MIXER	IF AMP	RCVR TOTAL
Intercept point/compression reference	output	–	input	output	output
Gain (dB)	28	-1	-10	20	37
Noise figure (dB)	2.5	1	10	5	2.65
1 dB compression (dBm)	8	–	13	10	7.7
Third-order intercept point (dBm)	18		+3	20	17.7
Second-harmonic intercept point (dBm)	31		26	33	3

TABLE 1

CUSTOM PRODUCTS

CUSTOM PRODUCTS ORDERING INFORMATION

MODEL NUMBER	IF FREQUENCY OPTION (*)	AVAILABLE OPTIONS
ARS309LC7	-	Contact Factory
LNB-1826-30	-	Contact Factory
LNB-2640-40	-	Contact Factory
DA40502LC7	-	Contact Factory
DA40208LC7	-	Contact Factory
DA40818LC7	-	Contact Factory
DSS0818	-	-
SYS40118C20(*)	A, B, C	-
IR3A8596LR6(*)	A, B, C	-
IR3A5459LR6(*)	A, B, C	-
SYS6474N01R	-	-
SYSTX3638	-	Contact Factory
SYS1840A24R	-	-
SYS1840N01R	-	-
LNB-7181-02	-	Contact Factory
SYS3436N01R	-	-
SYS0204N01R	-	-
SYS0118N01R	-	-
SYS0218N01R	-	-
SYS0318N01R	-	-
SYS0518N01R	-	-
SYS9.0N01R	-	-
SYS1015N01R	-	-
SYS0216N01R	-	-