Millimeter Wave Components & Subsystems

Product Catalogue Edition 8

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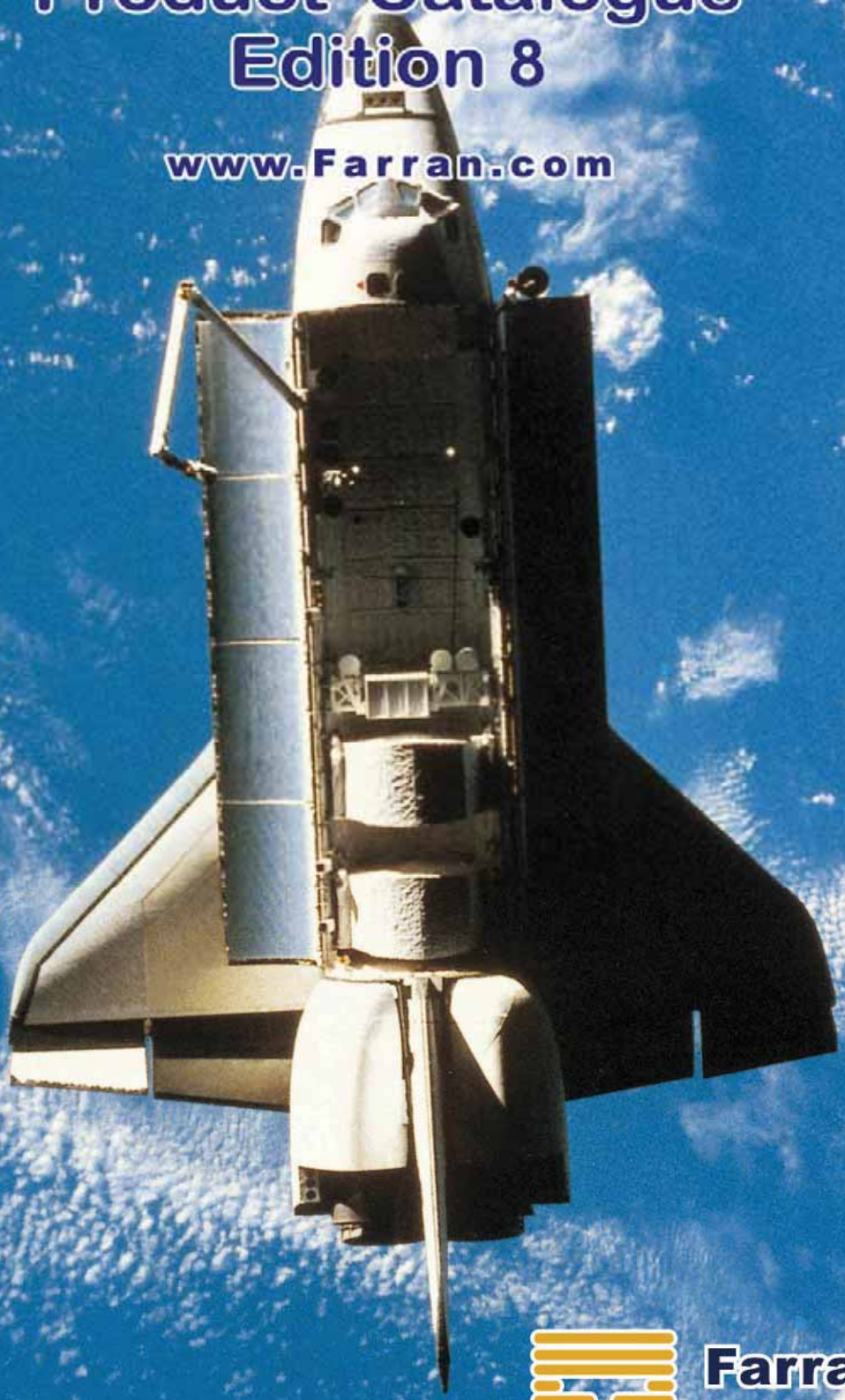


Farran Technology

Contents

Farran Technology
Millimeter Wave Components & Subsystems.

Contents

Farran Technology
Millimeter Wave Components & Subsystems.

Mixers and Detectors

Low Cost Planar Detectors to 170 GHz

Features

- Full Waveguide Bandwidth
- Zero Bias Operation
- Economical
- Rugged
- Light weight

Planar Detector Model WDP-10

Applications

- Test Systems
- Instrumentation
- Relative Power Measurements

Description

The FTL WDP-Series of detectors employs finline technology and zero biased beamlead Schottky barrier diodes. Full waveguide band operation is achieved with good sensitivity in a compact unit.

Models are offered in 9 bands between 18 and 170 GHz. The units are fixed tuned and operate without bias making them particularly convenient to use. Either output voltage polarity is available.

Applications are as sensors for network analysers and as low cost replacements for power heads.

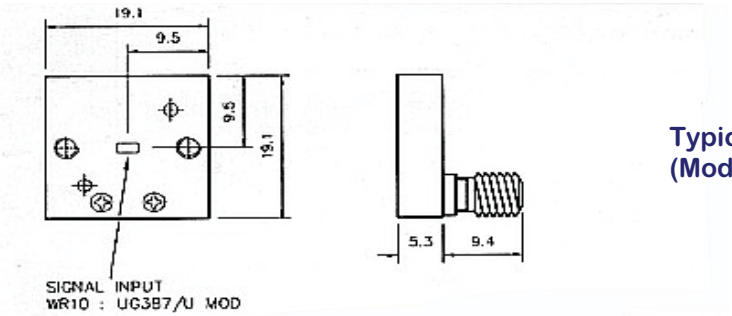
> Low Cost Planar Detectors to 170 GHz

Series WDP

> Electrical Specifications

Model	Freq.Band (GHz)	Waveguide Designation EIA	Flange Compatability	Sensitivity (mV/mW) Minimum	Flatness (dB) Max
WDP-42	18-26.5	WR42	UG595/U	2000	± 1
WDP-28	26.5-40	WR28	UG599/U	1000	± 2
WDP-22	33-50	WR22	UG383/U-M	750	± 2
WDP-19	40-60	WR19	UG383/U	750	± 2
WDP-15	50-75	WR15	UG385/U	550	± 2
WDP-12	60-90	WR12	UG387/U	> 550 typ	± 2
WDP-10	75-110	WR10	UG387/U-M	> 550 typ	± 2
WDP-08	90-140	WR8	UG387/U-M	>220 typ	± 2
WDP-06	110-170	WR6	UG387/U-M	> 220 typ	± 2.5

Notes :
1. Voltage sensitivity is measured at –20 dBm into a 1 MOhm load at room temperature
2. Input power should not exceed 100 mW.
3. Other flanges on request.
4. VSWR < 2.0 typical for frequencies to 75 GHz, < 2.5 typical to 110 GHz.



Typical Outline Drawing (Model WDP-10)

Outline Drawing Model WDP-10

> How To Order

Specify model Number. Contact sales for special requirements.

Waveguide Detectors to 325 GHz

Features

- High Sensitivity
- Recontactable Diodes
- Internal Bias Unit Available
- Output Polarity Selectable
- Economical
- Rugged

Model WD-08 with optional bias network

Applications

- Test Systems
- Instrumentation
- Relative Power Measurement

Description

The FTL WD-Series of waveguide detectors offer high sensitivity over the frequency range 170-325 GHz in two standard waveguide bands. A whisker contacted GaAs Schottky barrier diode provides excellent sensitivity when operated with dc bias. Backshort tuning enables tuning for highest sensitivity at the frequency of interest, or fixed tuned versions offer full frequency coverage. An integral constant current bias unit, driven from a single 15 volt supply, is available as an option.

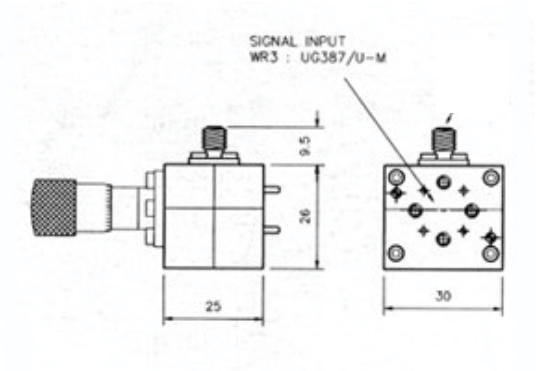
> Waveguide Detectors to 325 GHz

SERIES WD

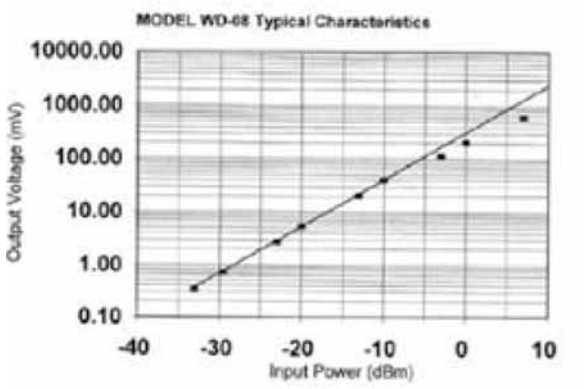
> Typical Electrical Specifications

Model	Freq.Band (GHz)	Waveguide Designation EIA	Flange Compatability	Sensitivity (mV/mW) Minimum	Typical Flatness (dB)
WD-12	60-90	WR12	UG387/U	2,750	±3.0
WD-10	75-110	WR10	UG387/U-M	2,750	±3.0
WD-08	90-140	WR8	UG387/U-M	2,750	± 3.0
WD-06	110-170	WR6	UG387/U-M	2,250	± 3.0
WD-05	140-220	WR5	UG387/U-M	2,000	± 3.0
WD-04	170-260	WR4	UG387/U-M	1,500	± 3.5
WD-03	220-325	WR3	UG387/U-M	1,000	± 4.0

Note:
1. Voltage sensitivity is measured at 50 µA bias current with –20 dBm into a 1 MOhm load, for backshort tuned models.
2. Maximum input power 10 mW.
3. Other flanges on request.
4. All Models use whisker contacted GaAs diodes.
5. We can offer an integrated AC/DC output amplifier as an option. Contact us for details.



Model WD-03



Typical transfer characteristics

> How To Order

Specify model Number with video and bias requirements.

Balanced Mixers

Features

- Planar GaAs Diodes
- Rugged Compact Design
- High Reliability
- Low Noise Figure Conversion Loss
- Broad Bandwidth
- Biased designs available

Model BMC-15 Waveguide Mixer for 60GHz applications

Applications

- Communications
- Radiometry
- Radar
- Laboratory Test Systems

Description

Farran Technology offers a wide variety of balanced mixers. These are based on planar technology and GaAs Schottky barrier beam lead diodes. They feature low conversion loss, low noise figure, excellent noise suppression and LO-RF isolation. The LO drive requirement can be reduced by operating the mixers with bias. They are extremely rugged devices of small physical size and mass. Designs are chosen from a portfolio of mixer architectures depending on the customer's detailed requirements. IF frequency coverage to at least 18 GHz is available and full RF/LO bandwidths may be provided in certain frequency bands.

> Balanced Mixers

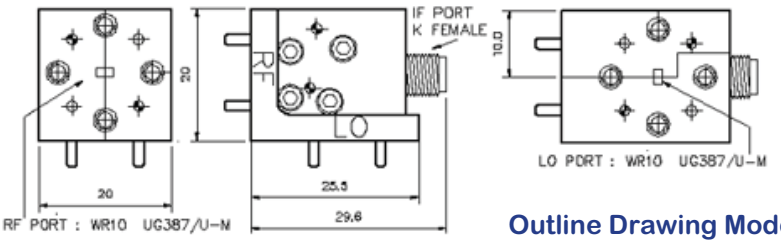
BMC SERIES

> Electrical Specifications

Model	RF Frequency Range (GHz)	Conversion Loss Typical (dB)	Noise Figure DSB Max (dB)
BMC-28	26.5-40	7	7
BMC-19	40-60	6	5.5
BMC-15	50-75	6.5	6.5
BMC-12	60-90	7	7
BMC-10	75-110	7.2	7.5
BMC-08	90-140	7.5	8.5
BMC-06	110-170	9	10
BMC-05	140-220	9	10

Note:

1. The Conversion Loss values are for IF bandwidth DC to 4 GHz. The BMC specs are for a fixed LO frequency and a 4GHz IF bandwidth.
2. RF/LO/IF VSWR typically < 2.5 : 1.
3. BMC-XXB Model uses bias to allow LO drive levels 0 to +3 dBm.
4. LO level +13 dBm as standard.
5. Consult factory with LO, RF and IF range for performance specifications.
6. IF bandwidths up to 40 GHz are available with fixed LO, for certain models, consult factory .
7. Models covering frequencies beyond 220 GHz are available, consult factory.
8. FTL recommends the use of a precision PSU (FDB-F4) for best practice protection of Schottky diodes in all mixers.



Outline Drawing Model BMC-10

> How To Order

Specify catalogue number together with any special requirements

Harmonic Mixers

Features

- Low conversion loss
- Flat frequency response
- Full band frequency coverage to W-band
- Unbiased anti-parallel diode pair employed
- Supplied with conversion loss calibration chart

Model WHMB-15

Applications

- Phase Locked Loops
- MM-Wave Instrumentation
- Signal Processing
- Spectrum Analysis

Description

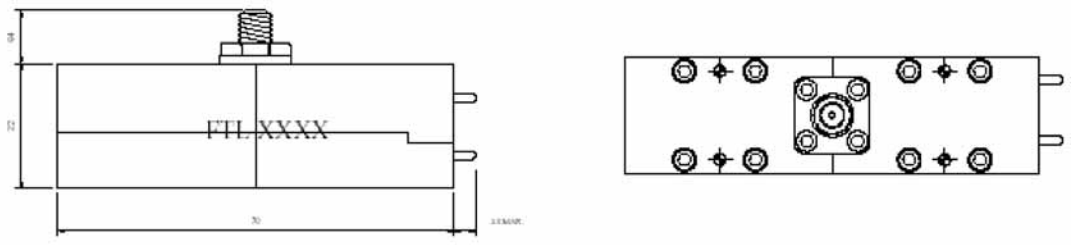
Farran Technology manufactures a comprehensive range of waveguide harmonic mixers for use with industry standard spectrum analyzers and other custom applications. Models WHMB are fully calibrated broadband balanced diode units covering 26.5-110 GHz in standard waveguide bands. We also offer a low cost general purpose model WHMP covering 26.5-170 GHz, and model WHM covering 140-325GHz.

> Harmonic Mixers

WHMB SERIES

> Typical Electrical Specifications

Model	WHMB-19	WHMB-15	WHMB-12	WHMB-10
Frequency Range(GHz)	40-60	50-75	60-90	75-110
LO Frequency Range (GHz)	10-15.2	8-13	10-15.2	9.4-14
Conversion Loss Max (dB)	20	25	32	38
Max Input Power (mW)	10	10	10	10
Max LO Level (dBm)	19	19	19	19
Waveguide Size	WR 19	WR 15	WR 12	WR 10
Waveguide Flange Compatability	UG383/U-M	UG385/U	UG387/U	UG387/U-M
Output Connector	SMA-F	SMA-F	SMA-F	SMA-F



Outline Drawing Model WHMB-15S Harmonic Mixer

> How To Order

Specify model Number. Contact the sales office with special requirements

Harmonic Mixers

WHM / WHMP Series

Features

- Zero Bias Planar Diode Designs
- Low Cost Planar Models to 170 GHz
- Tunable Models 170-325 GHz
- External or internal diplexers
- Internal Bias Regulator option

WHMP- 08 Harmonic Mixer

Application

- Phase Locked Loops
- MM-Wave Instrumentation
- Signal Processing
- Spectrum Analysis

WHM 05 Outline with Integral LO/IF

Description

FTL offer a comprehensive range of waveguide harmonic mixers encompassing low cost planar broadband versions to 170 GHz, complemented by high performance whisker contacted units for coverage to 325GHz and above. The harmonic mixers are available in the standard waveguide sizes. These mixers offer unparalleled performance for extending spectrum analyzers and other receiving systems. For extending spectrum analysis beyond 325 GHz, we can offer solutions based on our corner cube harmonic mixers CHM - Series.

> Harmonic Mixers

●●● WHM / WHMP Series

> Typical Electrical Specifications

Model	Frequency (GHz)	Conversion Loss (dB) typical	Waveguide Designation	Min. detectable Signal (dBm) [3]
WHMP-28	26.5-40	17	WR28	-65
WHMP-22	33-50	19	WR22	-60
WHMP-19	40-60	21	WR19	-58
WHMP-15	50-75	23	WR15	-55
WHMP-12	60-90	26	WR12	-52
WHMP-10	75-110	28	WR10	-50
WHMP-8	90-140	38	WR8	-48
WHMP-6	110-170	45	WR6	-44 typ
WHM-5	140-220	50-55	WR5	Conversion loss
WHM-4	170-260	50-60	WR4	is
WHM-3	220-325	55-65	WR3	tested

1. Conversion loss is typical, midband at harmonic number 10 or less up to 100 GHz.
2. Beyond 100 GHz conversion loss quoted represents performance for harmonic numbers < 20.
3. Using a Tektronix 2782 or similar spectrum analyzer, min detectable signal in 100KHz bandwidth is specified.
4. Models WHMP are zero bias planar units.
5. RF Range: Waveguide band for WHMP planar models. Tunable across waveguide band for WHM models.
6. LO Frequency: Standard range DC-18 GHz for WHMP Models. Frequencies outside these ranges can often be accommodated.
7. IF Frequency: to 18 GHz, typically the range DC -2.5 GHz. Frequencies outside these ranges can often be accommodated.
8. LO Power : +13 dBm min (usable range +6 to +15 dBm)
9. Max. combined RF + LO Power : 100 mW
10. DC Bias: - Not required for WHMP models.
    - Use external or internal bias tee with WHM models.
    - A bias regulator operating from a +15V can be supplied.
11. A FDB-F4 bias supply may also be used to monitor device current in WHM-series.
12. FTL recommends the use of a precision PSU (FDB-F4) for best practice protection of Schottky diodes in all mixers.
13. An external planar LO/IF diplexer can be supplied for use with WHMP-series:

Model	IF	LO
DIP-1	DC - 1 GHz	1.8 - 7.5 GHz
DIP-2	DC - 1 GHz	5 - 20 GHz
DIP-4	DC - 2.5 GHz	5 - 20 GHz

Subharmonically Pumped Mixers

Features

- Low Conversion Loss
- LO Operating at Half the Signal Frequency
- Separate Signal and LO Ports
- Inherent LO AM Noise Cancellation
- DC Bias not Required
- Wide IF Bandwidth

SPM-03 Subharmonic Mixer

Applications

- Radio Astronomy
- Plasma Diagnostics
- Atmospheric Sounding
- Laboratory Spectroscopy

Description

The subharmonically pumped mixer is favoured in lightweight, totally solid state receivers in the signal frequency range 75 to 220 GHz or above covered by a local oscillator in the frequency range 37.5 to 110 GHz. In order to achieve state-of-the-art receiver sensitivity, planar diodes with extremely low parasitics are used.

Farran Technology offers high performance subharmonically pumped mixers in the 75 to 220 GHz frequency range. These mixers have two antiparallel low noise, whisker contacted Schottky barrier diodes placed in the signal waveguide and feature several advantages over single diode mixers.

The LO operates at half the signal frequency and thus allows the use of lower cost solid state oscillators at mm-wave frequencies, $f_{LO} = (f_s +/- f_{if})/2$. Due to the anti-parallel diode circuit, local oscillator AM noise cancellation occurs inherently and therefore no LO injection scheme, e.g. a diplexer, is required. The LO filtering noise rejection is of the order 15 - 20dB. Also no DC bias is required for mixer operation.

The mixer incorporates separate input ports for the LO and signal frequency, each with its own backshort tuner. The mixer specifications are valid over a minimum tuning range of 10%. The LO power requirement is 8 -12mW. Maximum LO power is 30mW. A distinct advantage of the subharmonically pumped mixer is its inherently wide IF output bandwidth. A VSWR <= 2:1 is typically achieved over a 10 GHz wide IF bandwidth.

> Subharmonically Pumped Mixers

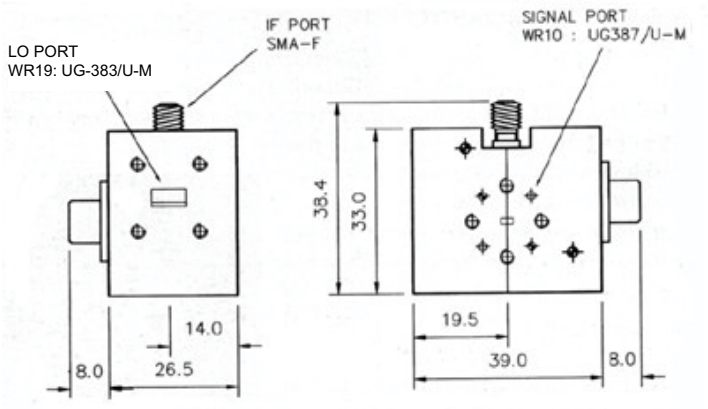
SERIES SPM

>Electrical Specifications

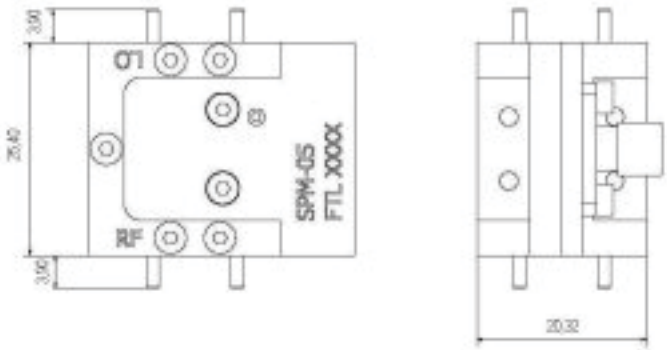
MODEL	Signal Frequency (GHz)	LO Frequency (GHz)	Mixer Conversion Loss[1] (dB, SSB)			RF Waveguide Size	RF Waveguide Flange Compatability	LO Waveguide Size	LO Waveguide Flange
			Typ.	Max	Typical LO Power (mW)				
SPM-12	60-80	30-40	<10.5	12.0	15-20	WR10	UG-387/U-M	WR28	UG599/U
SPM-10	80-110	40-55	<11.0	12.5	15-20	WR10	UG-387/U-M	WR19	UG-383/U-M
SPM-08	110-140	55-70	7.0	8.5	8	WR-8	UG 387/U-M	WR15	UG-385/U
SPM-06	140-170	70-85	8.5	9.5	10	WR-6	UG 387/U-M	WR12	UG-387/U
SPM-05*	170-220	85-110	5.0		3	WR-5	UG-387/U-M	WR10	UG-387/U-M
SPM-04	220	110				WR-4	UG-387/U-M	WR8	UG-387/U-M
SPM-03	280	140				WR-3	UG-387/U	WR6	UG-387/U
SPM-02	350	87.5				WR-2	UG-387/U	WR10	UG-387/U

Note:
1. Measured at an IF between 3.7 and 4.2 GHz, IF amplifier noise temperature 135K.
2. Broad IF band units are available e.g. 6-18 GHz or greater.
3. Consult factory with RF, LO and IF requirements for full specifications.
4. FTL recommends the use of a precision PSU (FDB-F4) for best practice protection of Schottky diodes in all mixers.

** Different Outline drawing applied for SPM-05*



Example 1:
Model SPM-10 Subharmonic Mixer (Fixed Tuned)
Dimensions in mm



Example 2:
Model SPM-05* Subharmonic Mixer (Fixed Tuned)

Typical Outline Drawings

> How To Order

Specify model Number. Contact the sales office with special requirements

> Subharmonically Pumped Mixers

>> SPM-05 183 GHz Subharmonic

Applications

- Heterodyne Receivers
- Instrumentation
- Imaging

Features

- Low Noise Figure
- Low LO power level
- Low conversion Loss

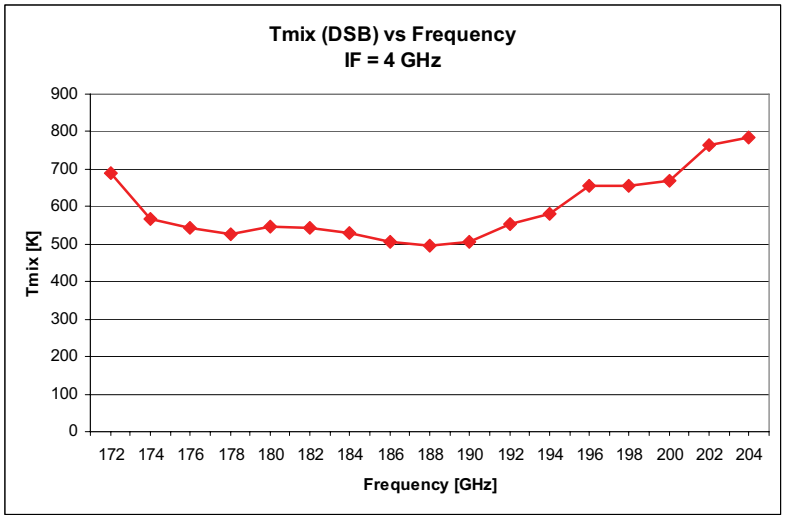
Product features	Min	Typ	Max	Unit
RF Frequency	172	-	204	GHz
LO Frequency	84	-	100	GHz
IF Frequency	0.2	-	4	GHz
NF DSB	-	4.4	5	dB
Tmix DSB	-	500	800	K
LO Drive Level	-	4	-	mW
RF Waveguide	WR-5 UG-387/U-M			
LO Waveguide	WR-10 UG-387/U-M			
IF Connector	SMA Female			

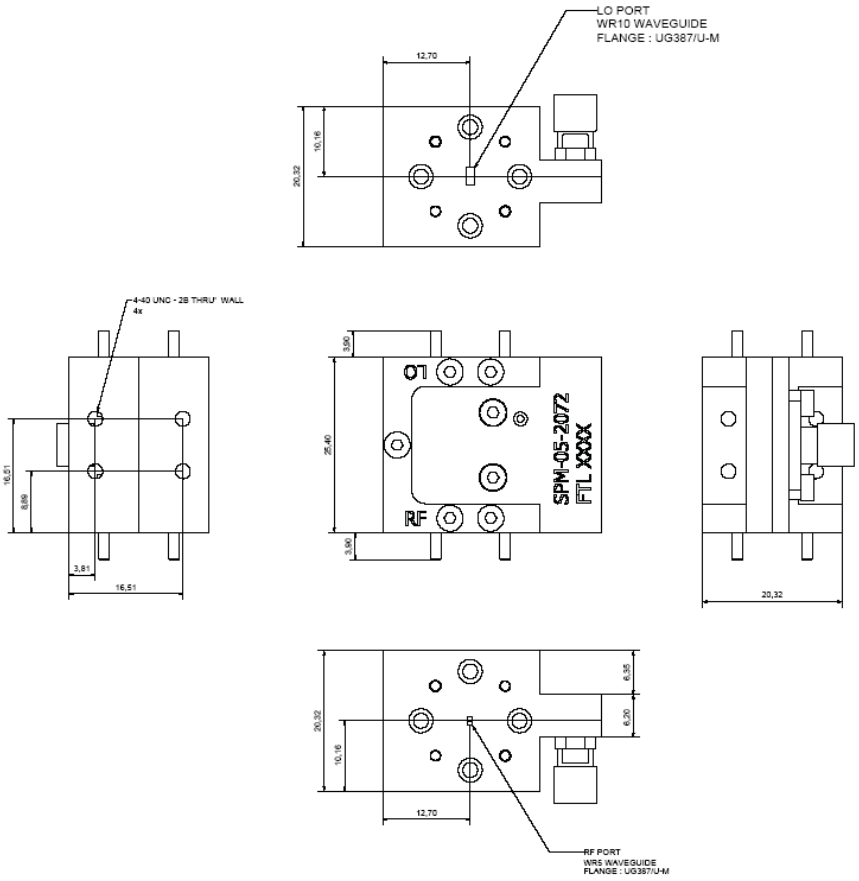
Description

A high performance subharmonically pumped mixer in the WR-05 band.

> Subharmonically Pumped Mixers

>> SPM-05 183 GHz Subharmonic





Note:
Farran Technology reserves the right to change, without notice, the characteristic data and other specifications applied to this product. The product may be subject to Irish export restrictions.

SOURCES

> Gunn Oscillators

>> Narrow-band, High-power, Mechanically-tuned Gunn Oscillators

Features

- High Output Power
- Fixed Frequency or Monotonic Mechanical Tuning
- Bias Tunable for AFC and Phase Locked Operation
- Micrometer-tuning

Applications

- Transmitters
- Local Oscillators
- Frequency Multiplier Pumps
- Test/ Instrumentation Sources

Description

Farran offers a range of millimeter-wave Gunn oscillators which are ideally suited for use as local oscillator/pump sources with mixers and frequency multipliers. Their high output power also makes them suitable for use as transmitter sources.

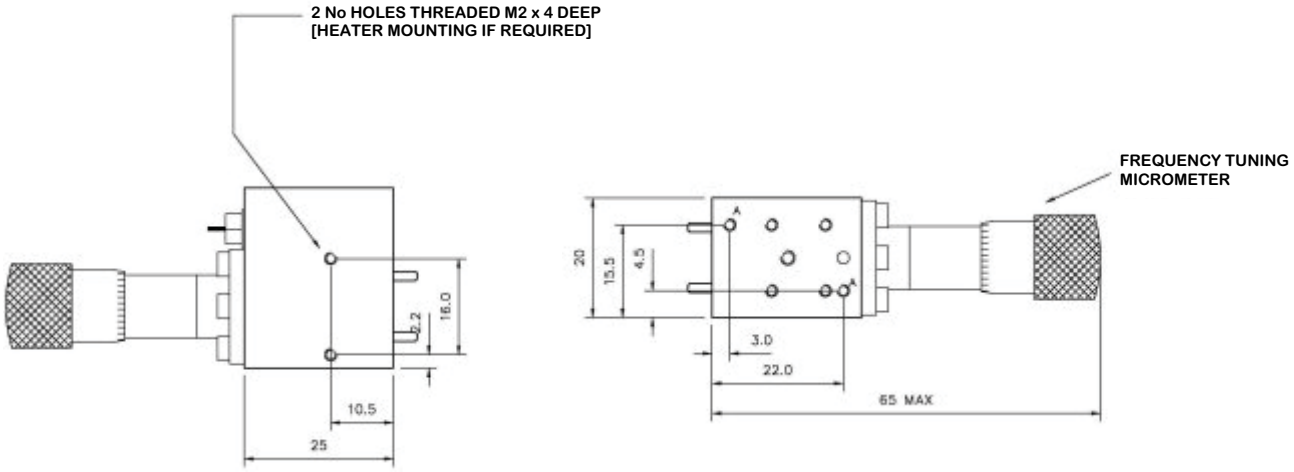
Where applications do not require tunable sources, the units are supplied as fixed frequency oscillators. Tunable versions utilise mechanical tuning, which are supplied with FTL's micrometer drive for convenient, repeatable tuning. Narrow band high power units use screw tuners. Electronic tuning of the order of at least +/- 50 MHz can be achieved with bias pushing.

Units with integral heater and temperature control are available to limit frequency drift to less than 1 MHz / deg C typically. Contact FTL for further details.

> Gunn Oscillators

>> Narrow-band, High-power, Mechanically-tuned Gunn Oscillators

Model	Frequency (GHz)	Waveguide (EIA)	Flange	Output Power (mW)	Tuning Range (GHz)
GO-28	26-35	WR28	UG381/U	300	±3
GO-22	35-45	WR22	UG383/U	250	±3
GO-19	40-50	WR19	UG383/U-M	200	±3.5
GO-15	50-60	WR15	UG385/U	200	±4
GO-15	60-70	WR15	UG385/U	100	±5
GO-12	70-80	WR12	UG387/U	80	±6
GO-12	80-90	WR12	UG387/U	60	±4
GO-10	90-110	WR10	UG387/U-M	30-45	±3
GO-08	110-140	WR8	UG387/U-M	15	±3



Note:

1. Tunable Models cover typically ± 2.5 GHz using a micrometer drive

> Gunn Oscillators

>> Mechanically Tuned Gunn Oscillators Narrow Band

Features

- High Output Power
- Fixed Frequency or Monotonic Mechanical Tuning
- Bias Tunable for AFC and Phase Locked Operation

Model GN-10 (Mechanically Tuned Gunn Oscillator)

Applications

- Transmitters
- Local Oscillators
- Frequency Multiplier Pumps
- Test/ Instrumentation Sources

Description

FTL offers a range of millimeter-wave Gunn oscillators which are ideally suited for use as local oscillator/pump sources with mixers and frequency multipliers. Their high output power also makes them suitable for use as transmitter sources.

Where applications do not require tunable sources, the units are supplied as fixed frequency oscillators. Tunable versions utilize mechanical tuning, which are supplied with FTL's micrometer drive for convenient, repeatable tuning. Narrow band high power units use screw tuners. Electronic tuning of the order of at least +/- 50 MHz can be achieved with bias pushing.

Units with integral heater and temperature control are available to limit frequency drift to less than 1 MHz / deg C typically. Contact FTL for further details.

> Gunn Oscillators

>> Mechanically Tuned Gunn Oscillators Narrow Band

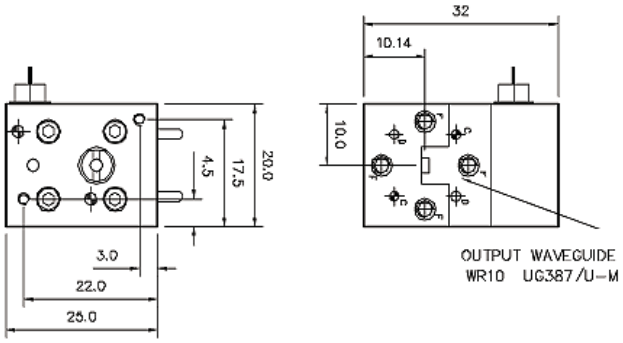
> Typical Electrical Specifications

NARROW BAND HIGH POWER MECHANICALLY TUNED GUNN OSCILLATORS

Model	Waveguide	Frequency Range (GHz)	Output Power (mW)	Mechanical Tuning Min. (MHz)
GN-28	WR28	26.5-40	10-300	±50
GN-22	WR22	33-50	10-250	±50
GN-19	WR19	40-60	10-200	±50
GN-15	WR15	50-75	10-100	±75
GN-12	WR15	60-90	10-80	±75
GN-10	WR12	75-100	10-50	±75

Note:

2. FTL recommends the use of a precision PSU (FDB-F8) for best spectral purity on all narrow band Gunn devices.
3. FTL recommends Isolators/Circulators for best practise and performance in all Gunn applications.
4. Tunable Models cover typically ±2.5GHz using micrometer drive.
5. Specify Model GO for micrometer tuning.
6. Higher power outputs are available at selected frequencies



Typical Outline Drawing Model GN-10

> How To Order

Specify Model Number - FR - OP - MT - MG

- *Frequency in GHz** — FR
- Output Power — OP
- Mechanical Tuning — MT
- Waveguide — MG

* If a frequency band is to be covered, specify here centre frequency and separately frequency band and step size.

Example :

To order a Gunn Oscillator Model GN-22, Frequency Range 35-45 GHz, Output Power 250 mW and Mechanical Tuning ± 50, please specify :

GN-22-40-250-50

> Gunn Oscillators

>> Varactor Tuned

Features

- Fast Electronic Tuning
- High Output Power
- Minimal Power Variation
- Mechanical Tuning Option
- Wideband Electronic Tuning
- High Modulation Rates

Model GV-15
(60 GHz Gunn Oscillator
with external isolator)

Applications

- FM Sources/Transmitters
- Phase-Locked Loops
- FM Receivers
- Swept Sources (Test/Instrumentation)
- Frequency Multiplier Pumps
- AFC Local Oscillators

Description

While bias-tuned Gunn oscillators are suitable in many applications requiring frequency control, in those cases where the modulating signal frequency is very high or the tuning range is large, an alternative method of electronic tuning is required. FTL's range of varactor-tuned Gunn oscillators has been developed to meet these requirements.
The modulating signal frequency may be very high (into the microwave region if necessary) and the varactor tuning range has been achieved with high output power and minimal power variation. Wideband units and units fitted with mechanical tuning are also available. Highly linear VCO tuning characteristics are available for use with digital radio modulation schemes.
Two basic types of varactor tuned Gunn are available; series tuned and parallel tuned. The series tuned versions offer the maximum tuning bandwidth at the expense of output power. Parallel tuned designs deliver the greater power levels but have restricted bandwidth.

> Gunn Oscillators

>> Varactor Tuned

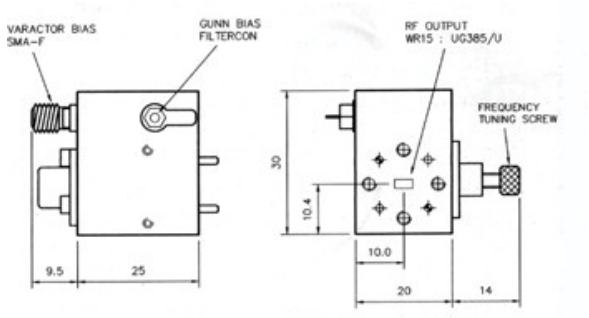
> Typical Electrical Specifications

STANDARD VARACTOR TUNED GUNN OSCILLATORS

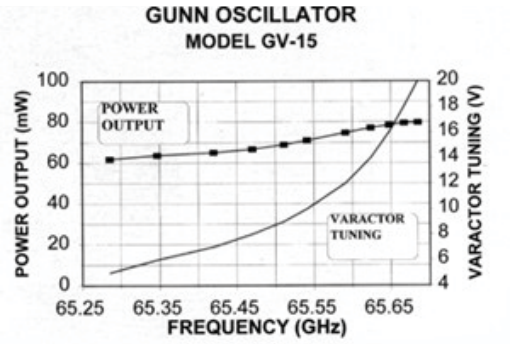
Model	Waveguide	Frequency (GHz)	Output Power Min. (mW)	Electrical Tuning (MHz)
GV-42	WR-42	18-26	150	300
GV-28	WR-28	26-35	150	350
GV-22	WR-22	35-45	150	500
GV-19	WR-19	50-60	75	500
GV-15	WR-15	50-60	100	500
GV-15	WR-15	60-70	80	500
GV-12	WR-12	70-80	60	500
GV-12	WR-12	80-90	40	500
GV-10	WR-10	90-100	20	500

Note:

1. For requirements beyond 100GHz we suggest higher power injection locked designs.
2. FTL recommends Isolators/Circulators for best practice and performance in all Gunn applications.



Typical Outline GV-15



Typical Performance
Model GV-15

> How To Order

Specify Model Number - FR - OP - ET

Electrical Tuning

* If a frequency band is to be covered, specify here centre frequency and separately frequency band and step size.

Example :

To order a Gunn Oscillator Model GV-15, Frequency 60-70 GHz, Output Power 80 mW, Electrical Tuning 500MHz and Waveguide WR15, please specify :
GV-15-65-80-500-WR15.

> Gunn Oscillators

>> Wideband

Features

- Wide Mechanical Tuning Range
- No Isolator Required
- Bias Tunable for AFC and Phase-Locked Operation

Model GMB-15
(Wideband Mechanically Tuned Gunn Oscillator)

Applications

- Transmitters
- Local Oscillators
- Frequency-Multiplier Pumps
- Test/Instrumentation Sources

Description

FTL's GMB Series of Gunn Oscillators are designed to provide moderate output power over a wide mechanical tuning range. The units operate in a harmonic mode and can therefore be operated without isolators.
They are supplied with a calibration chart which allows the operator to set the frequency range using a micrometer. Power output is optimised independently using a separate micrometer.
The oscillators are particularly suitable for use in frequency response measurements and as general purpose sources in test laboratories. They can be readily phase-locked or bias pushed over a narrow frequency range, using the bias port.
Both Indium Phosphide and Gallium Arsenide devices are employed, depending on the specifications required.

> Gunn Oscillators

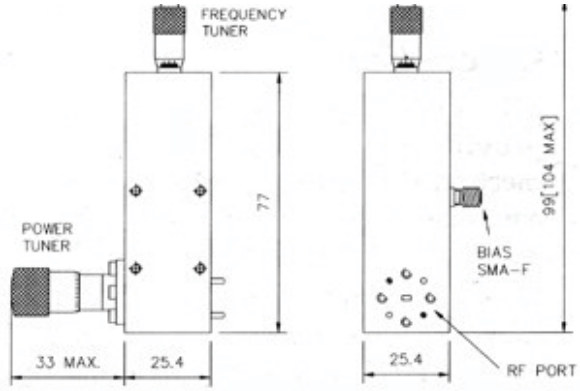
>> Wideband

> Typical Electrical Specifications

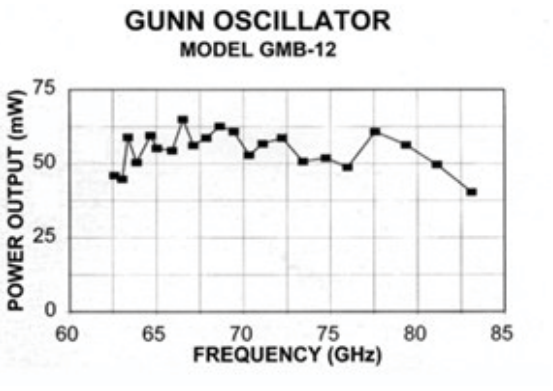
Model	Waveguide	Frequency Range (GHz)	Output Power (mW) Typ.
GMB-15	WR15	50-60	40
GMB-12	WR12	60-75	40
GMB-10	WR10	75-90	30
GMB-10	WR10	90-105	25

Note:

1. FTL recommends Isolators/Circulators for best practise and performance in all Gunn applications.
2. This is the range for standard products within the band. Higher power outputs are available at selected frequencies



Typical Outline
GMB-Series



Typical Performance
Model GMB-12

> How To Order

Specify Model Number - FR - OP

Frequency in GHz*

Output Power

* If a frequency band is to be covered, specify here centre frequency and separately frequency band and step size.

Example:

To order a Gunn Oscillator Model GMB-12, Frequency 60-75 GHz, Output Power 40 mW and Waveguide WR12, please specify **GMB-12-70-40-WR12**.

Phase Locked High Frequency Source Chain

Features

- High Power
- Low Noise
- High Stability
- Compact Size
- Custom Designs Available

Applications

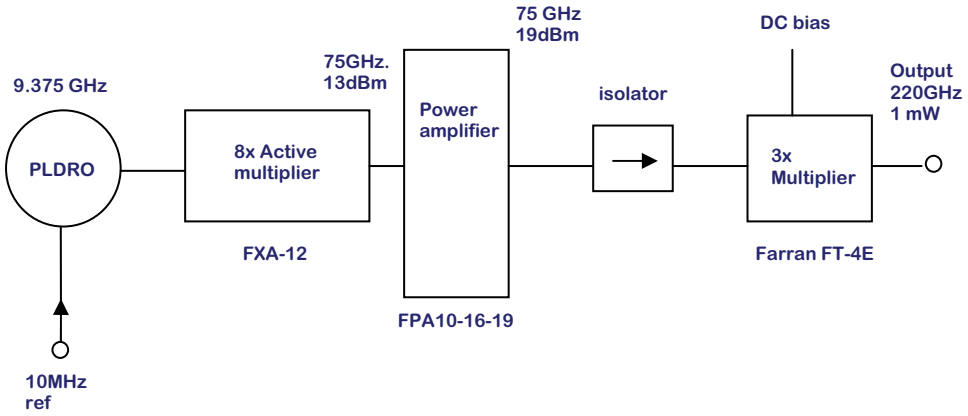
- Receiver Local Oscillators
- Coherent Reference Sources
- Transmitters
- CCTV
- WLAN

Description

The ever increasing complexity and sophistication of today's systems are imposing more stringent performance requirements on the oscillator sources that are used as system building blocks. For many applications the frequency stability and the phase noise properties of a free running Gunn oscillator are inadequate. These characteristics can be substantially improved by phase locking the oscillator to a lower frequency reference oscillator. The frequency reference can be a fixed frequency high stability crystal oscillator supplied as an integral part of the PLDRO or an external oscillator. The reference source is normally a phase locked oscillator itself operating as standard at 10 MHz or 100MHz.

> Phase Locked High Frequency Source Chain

>> 220GHz



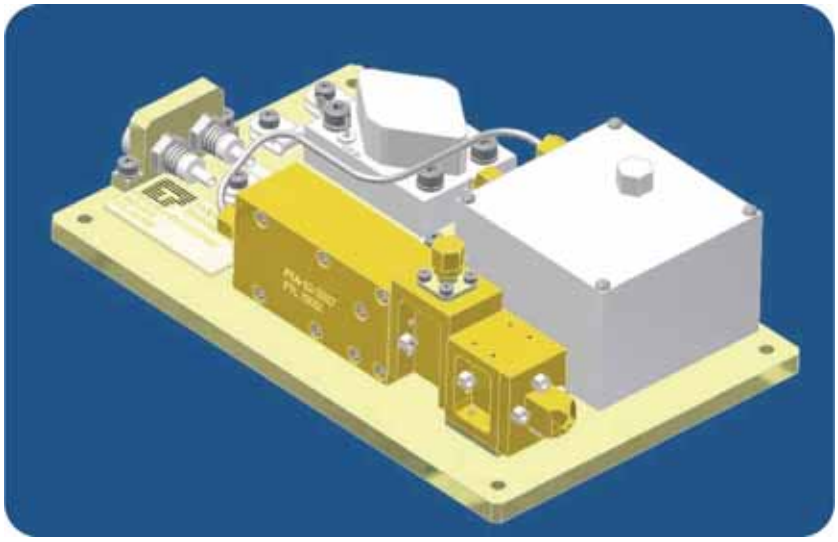
220GHz Low noise phase locked source

Sub-System specification :

Output centre frequency:	220 GHz
Bandwidth:	+/- 3.6 GHz
Output power:	1mW minimum
Phase noise:	-80dBc/Hz at 10 KHz
Driving source:	PLDRO @ 9.375 GHz
Reference source:	10MHZ

> Phase Locked High Frequency Source Chain

>> 444GHz



SPECIFICATIONS:

Operating Frequency:	444GHz
Output Power:	100μW minimum
Reference Frequency:	10MHz
Reference Power:	+3dBm (2mW) typical
DC Power:	+12V @ 1A typical 1.5A maximum

Multipliers

> Active Multipliers

Farran Technology Limited offers its capability in the custom design and manufacture of Mm-Wave Active Multipliers.

We specialize in custom designed MMIC based amplifiers, multipliers and sub-assemblies. These active multiplier products use MMIC based or hybrid components to offer the highest performance at lowest cost. The nominal output frequency range is 10-100 GHz although combinations with waveguide based multipliers can extend the range to beyond 300 GHz.

Integrated Assembly - Mechanical

The active multiplier consists of a driver amplifier, doubler and power amplifier integrated within a single housing complete with the necessary bias and control circuits.

MMIC Based Multipliers

DOUBLERS

Model Name	Input Freq (GHz)	Output Freq (GHz)	Typical Power
FDA-K/28	10 - 20	20 - 40	+22dBm
FDA-22	19 - 22	39 - 44	+31dBm

TRIPLERS

Model Name	Input Freq (GHz)	Output Freq (GHz)	Typical Power
FTA-28	10.1 - 10.45	30.3 - 31.35	+3dBm
FTA-22	13.8	41.4	+18dBm
FT-10	26 - 30	80 - 90	-5dBm

QUADRUPLERS

Model Name	Input Freq (GHz)	Output Freq (GHz)	Typical Power
FQA-K	6.6 - 7.5	26.4 - 30	+15dBm
FQA-28	8.75	35	+15dBm
FQA-19	10.9	43.6	+10dBm
FQA-15	14 - 16	56 - 64	+15dBm

X MULTIPLIER

Model Name	Input Freq (GHz)	Output Freq (GHz)	Typical Power
FXA-12	9 - 10.25	72 - 82	+13dBm

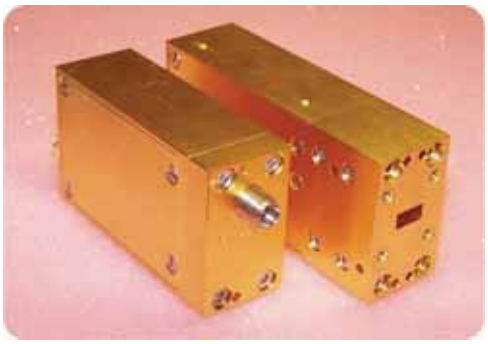
Please contact our sales representatives with your specific Requirements.

> Active Multipliers

>> FDA-K/28

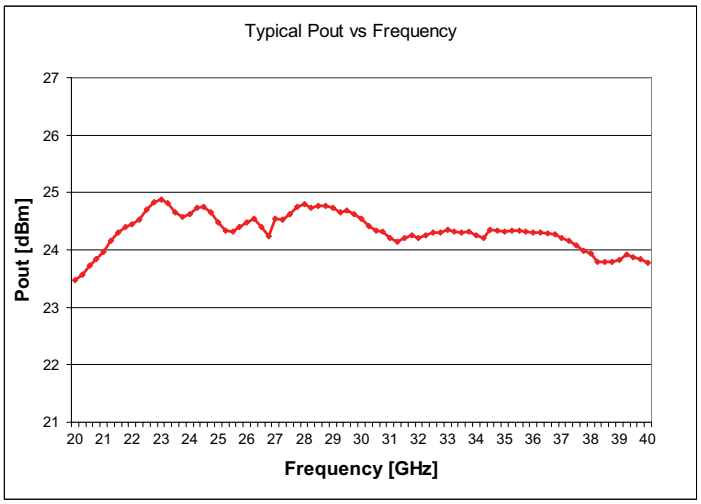
Applications

- LO chains
- Radar sources
- Communication sources
- Test equipment



Features

Product features	Min	Typ	Max	Unit
Input frequency	10	-	20	GHz
Output frequency	20	-	40	GHz
Multiplication factor	-	2	-	-
Pin	-	5	10	dBm
Pout	*	-	24	dBm
Harmonics Level	-	-30	-20	dBc
Supply Voltage	6	-	12	V
Current	-	900	1100	mA



Description

A general purpose MMIC packaged x2 multiplier in the Ka-band frequency range.

**K-type or WR-28 output available.

> Active Multipliers

>> FDA-K/28

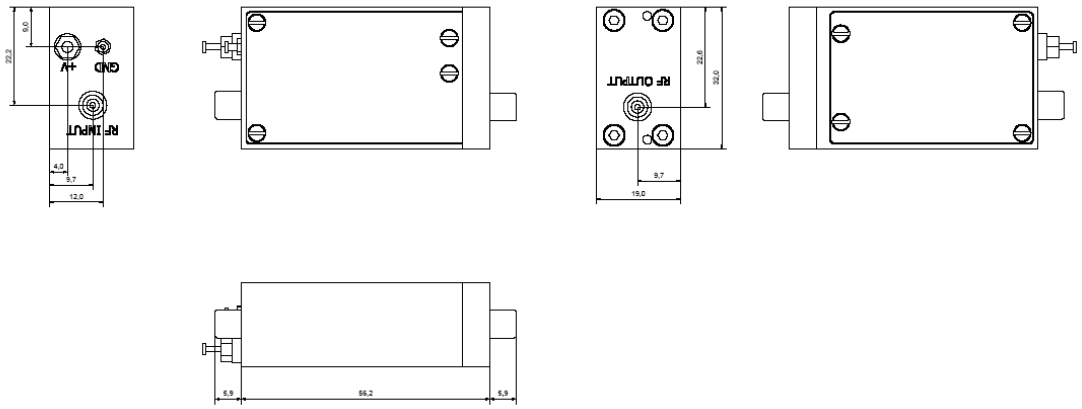


Figure 1. FDA-K outline.

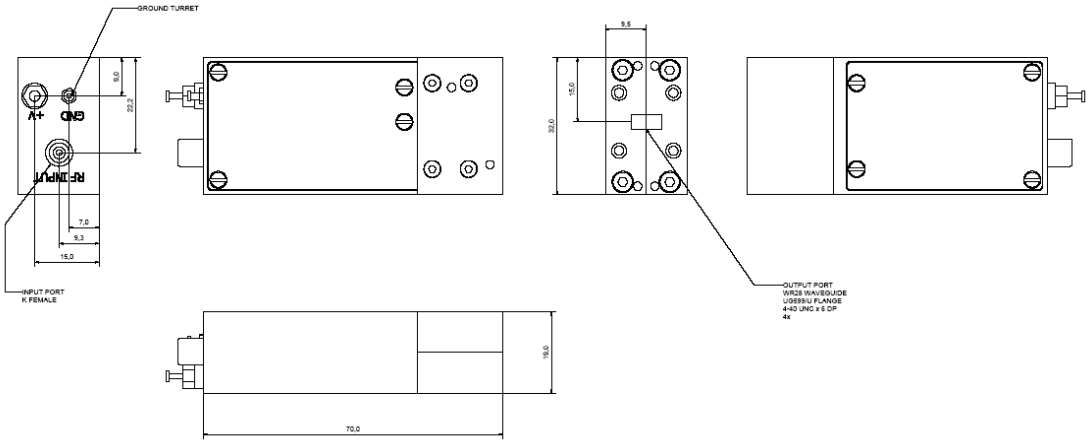


Figure 2. FDA-28 outline.

Notes :

1. The data contained in this document describes new products in the pre-production phase of development, and is for information only. Farran Technology reserves the right to change, without notice, the characteristic data and other specifications applied to this product. The product may be subject to Irish export restrictions.
2. * Lower Output power available. Please contact Farran Technology directly for more information.
3. ** FDA-28 output frequency is limited by the waveguide cut-off at 21.1 GHz

> Active Multipliers

>> FXA-12 High Power Active Multiplier.

Applications

- LO chains
- Radar sources
- Communication sources
- Test equipment

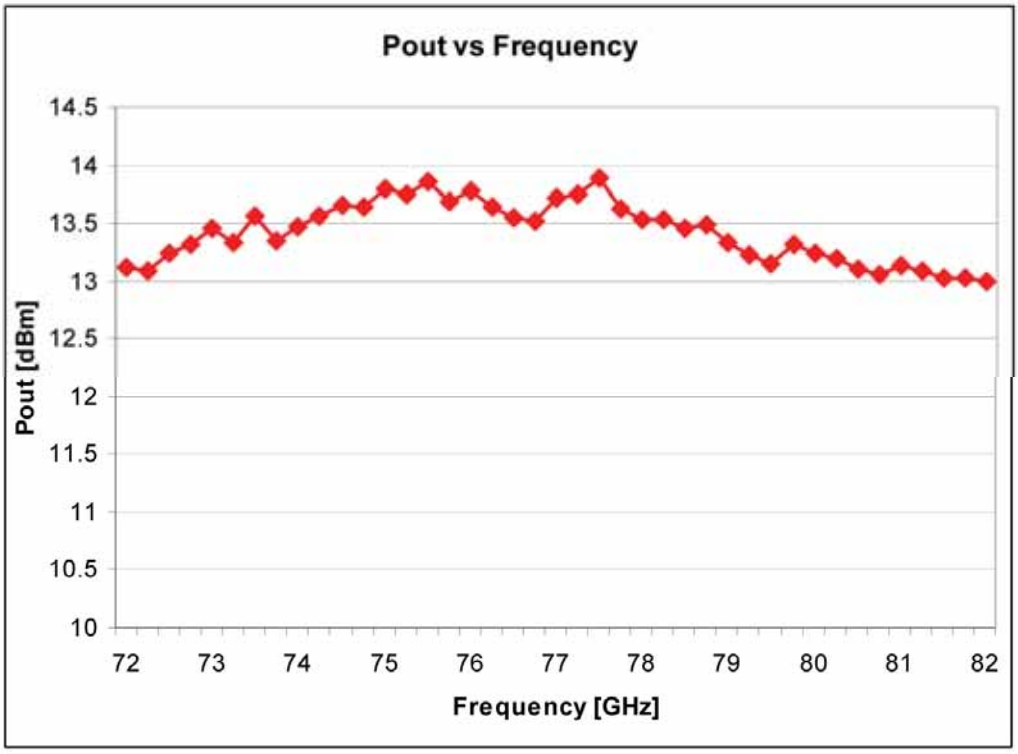
Features

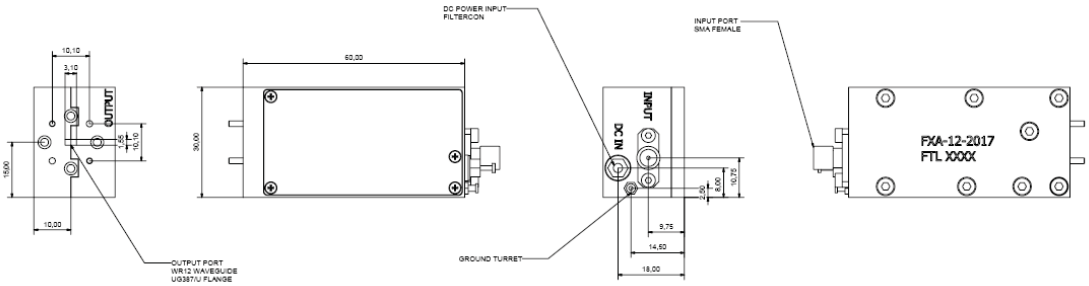
Product features	Min	Typ	Max	Unit
Input frequency	9		10.25	GHz
Output frequency	72		82	GHz
Multiplication factor		8		
Pin		10	13	dBm
Pout		13		dBm
Harmonics Level		-40	-30	dBc
Supply Voltage	8		15	V
Current		720	850	mA

Note :
1. High Pout available, +18dBm

> Active Multipliers

>> FXA-12 High Power Active Multiplier.





> How To Order

Contact the sales office with specific requirements

Frequency Converters

> Downconverters

>> Standard

Features

- Broadband RF bandwidths
- Variety of LO configurations and Gain options
- Includes BMC balanced mixers and GN Series Gunn Oscillators.
- Integrated assembly to standard or custom specifications
- Low noise figure
- Highest quality and reliability

Model BDC-28

Applications

- Frequency extenders to existing hardware
- Communications
- OEM test instrumentation
- ECM systems
- Radar front ends
- Radiometry

Description

A range of broadband downconverter modules from 26.5 – 110 GHz have been developed based on the successful BMC-series of balanced mixers and temperature stabilized GN-series Gunn Oscillators.
These block downconverters allow existing microwave hardware such as receivers, test equipment, etc, to be extended into the mm-wave spectral region. Low noise figures are achieved over greater than 15 GHz bandwidths and the temperature stabilized Gunn oscillators provide stabilities of the order ±35 MHz over an operating range 15-25°C (eg. BDC-28 Model).
Higher stability local oscillators such as PLO's can also be provided. As standard, image rejection filtering is integral.

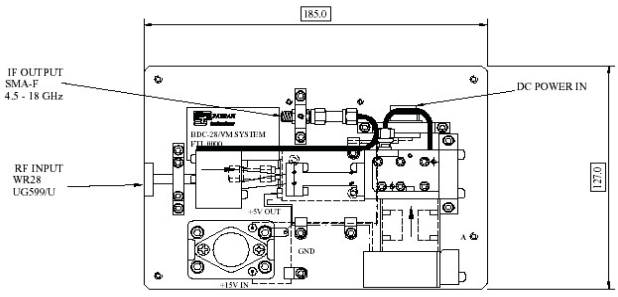
> Downconverters

>> Standard Model BDC

> Typical Electrical Specifications

Model	Freq.Band (GHz)	Noise Figure (dB max, SSB) EIA	LO Stability (MHz)	Input Waveguide	Output Connector
BDC 28	26.5-40	15.0	±35	WR28	SMA-F
BDC 22	36.5-50	15.0	±35	WR22	SMA-F
BDC 15L	50-63.5	16.5	±35	WR15	SMA-F
BDC 15H	62.5-75	16.5	±35	WR15	SMA-F
BDC 15H LNA	58-67	10.0	±35	WR15	SMA-F
BDC 15H LNA	61.5-75	10.0	±35	WR15	SMA-F
BDC 12	66.5-80	16	±45	WR12	SMA-F
BDC 10S	75-88.5	18	±50	WR10	SMA-F
BDC 10S	86.5-100	18	±50	WR10	SMA-F
BDC 10S	96.5-110	18	±50	WR10	SMA-F

Notes :
1. Other RF & IF ranges can be accommodated.
2. LO is normally chosen to be USB of the RF band.
3. Noise figure includes image rejection filter loss.
4. LO stability performance is worst case over a 15 to 25 C operating range.
5. Power Requirements 15V, 2A typ.
6. RF input VSWR 1.4:1max.
7. The image rejection in all models is 30 dB min.
8. Minimum Overall Gain in all models is 10.0 dB or customer specified.
9. Contact FTL for full specifications of these modules.



Typical Outline Drawing (Mobel BDC-28)

> How To Order

Consult the factory with your specification using the above table for guidance.

> Downconverters

>> Standard
Model BDC-K Downconverter

Features

- Low Noise Figure and good Spurious signal rejection.
- Designed to be small outline in a slim-line (height 10mm) body (BDC-K-26.5-18..26.5GHz and BDC-K-40-26.5..40GHz).
- Built-in local oscillator BDC-K-40-18..40GHz.

Applications

- Frequency extenders to existing hardware
- Communications
- OEM test instrumentation
- EW and ECM systems
- Radar front ends
- Radiometry

Description

Models BDC-K-26.5-18..26.5GHz & BDC-K-40 - 26.5..40GHz are down-converters available in 18-26.5GHz and 26.5-40GHz frequency range for use with a 2-20GHz tuned receiver. It has an LO input @ 14.5GHz. The RF input connection is a K type connector and the IF output is a SMA type connector.

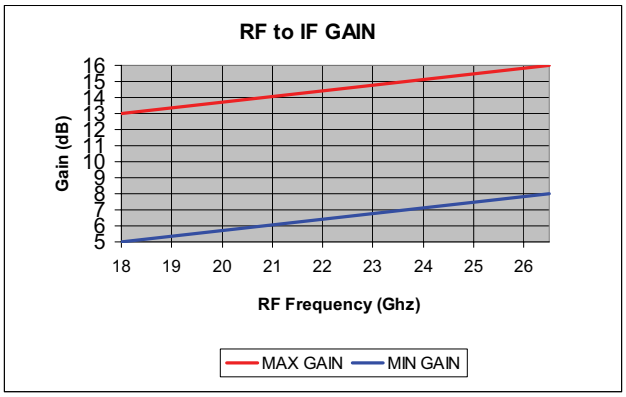
Model BDC-K-40 - 18..40GHz is an 18-40GHz down-converter for use with a 2-20GHz tuned receiver. The RF input connections are K type connectors and the IF output is a SMA type connector. The down-converter can operate in two bands, 18-26.5GHz (LO = 29GHz) and 26.5-40GHz (LO = 43.5GHz), with the IF output in the range 2.5-17.5GHz to make it compatible with existing communications equipment. It is designed to be compact size, with low noise figure and spurious, and has a built-in local oscillator. The local oscillator consists of a Dielectric Resonator Oscillator (DRO) which is phase locked to an internal reference. The internal reference may in turn be locked to an external 10 MHz reference.

> Downconverters

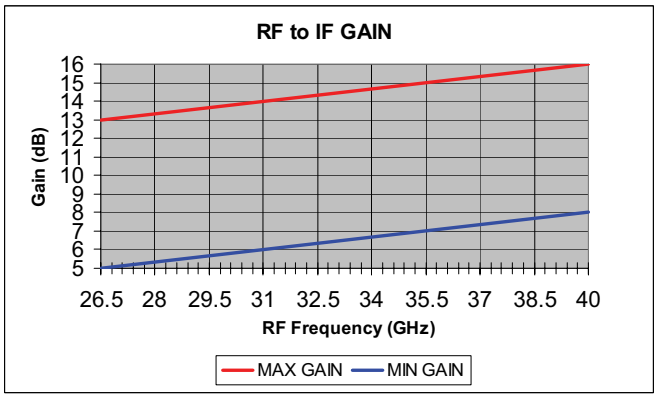
>> Standard
Model BDC-K Downconverter

> Typical Electrical Specifications

MODEL	BDC-K-26.5-18..26.5GHz	BDC-K-40-26.5..40GHz	BDC-K-40 - 18..40GHz
RF input Band1	18-26.5GHz	26.5-40GHz	18GHz – 26.5GHz
RF input Band2	N/A	N/A	26.5GHz – 40GHz
LO input	14.5 GHz @ -3 to 0dBm (supplied by customer)	14.5 GHz @ -3 to 0dBm (supplied by customer)	Internal LO Phase locked to ext.10MHz reference
IF output	2.5 – 11 GHz (2*LO conversion)	3.5 – 17 GHz (at 3*LO conversion)	2.5 – 17 GHz Band 1 LO 29 GHz Band 2 LO 43.5GHz
RF to IF Gain	see the graphs below	see the graphs below	12dBm min 18dBm max
Noise Figure	13 dB maximum	13 dB maximum	13 dB maximum
Spurious Rejection	-40dBc when -40dBm applied at RF port	-40dBc when -40dBm applied at RF port	-40dBc when -40dBm applied at RF port
VSWR	2.5:1 typical	2.5:1 typical	2.5:1 typical
Rails	5V / 0.9A max	5V / 1.5A max	+12V / 0.85A max +5V / 1.7 A max



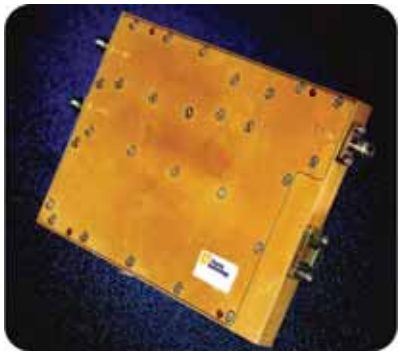
BDC-K-26.5-18..26.5GHz



BDC-K-40-26.5..40GHz

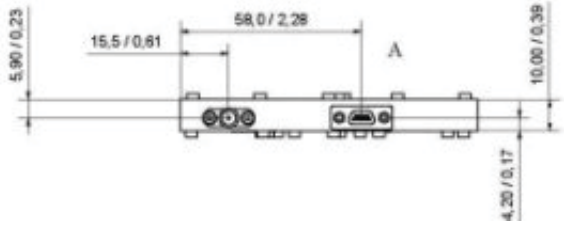
> Downconverters

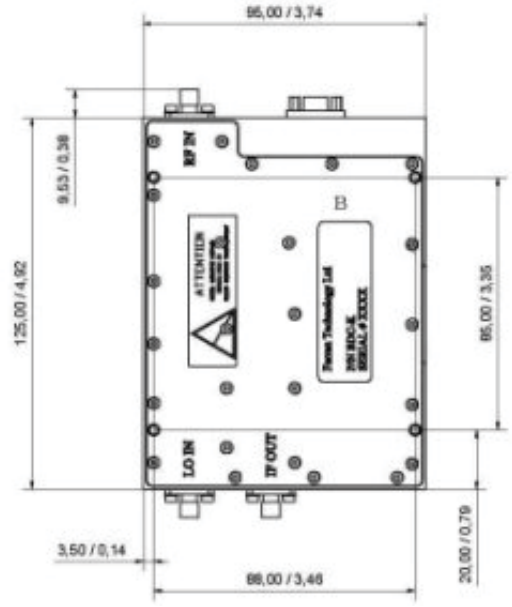
>> Standard
Model BDC-K Downconverter

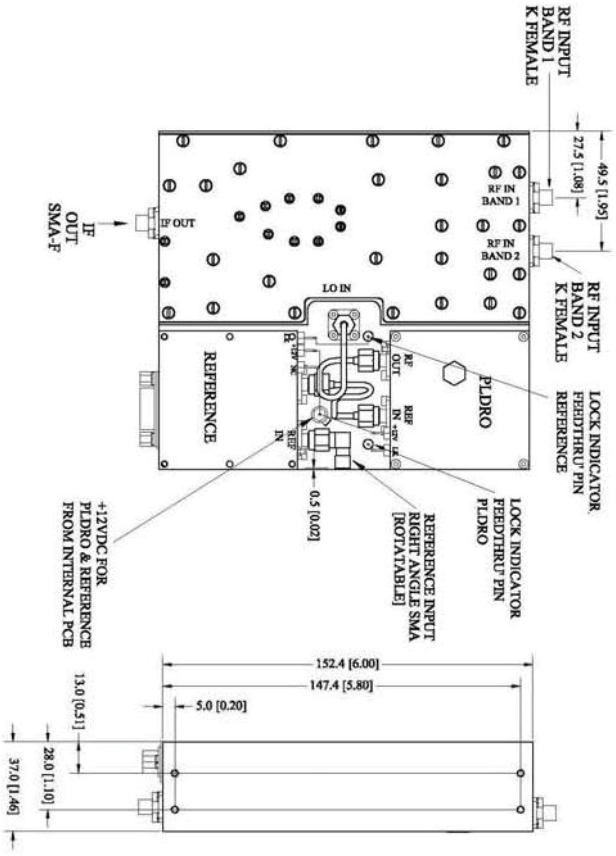


Model: BDC-K-26.5-18..26.5GHz
BDC-K-40-26.5..40GHz

Model: BDC-K-40-18..40GHz







> How To Order

Consult the factory with your specification using the above table for guidance.

> Downconverters

>> Custom Designs
Model BDC-28 IRS

Features

- Low Noise Figure
- Temperature compensated gain
- Integrated LO multiplier
- Integrated LO PLDRO Option
- Integrated LO Synthesiser Option

Model BDC-28 IRS

Applications

- Communications
- Radar Front-ends
- Test Instrumentation
- Frequency Extension
- Imaging
- Radiometry

Description

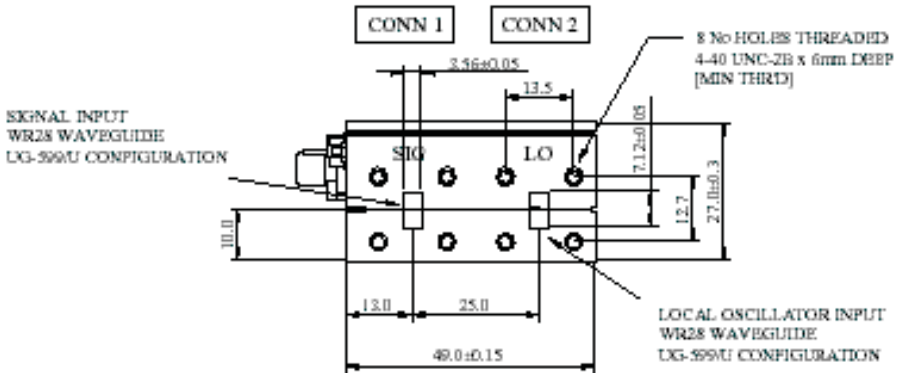
The unit features a low noise RF (Radio Frequency) front-end that includes a low loss waveguide-to-microstrip transition and a cascade of two MMIC LNA's. This is followed by a MMIC mixer chip which, in conjunction with an IF hybrid, provides greater than 15dB image rejection over the specified frequency range. The LO for the unit is fed through a waveguide-to-microstrip transition to a MMIC amplifier to provide sufficient drive to the mixer. The unit allows both USB (Upper Sideband) and LSB (Lower Sideband) operation where both sidebands can be extracted simultaneously. The IF is extracted from the mixer, amplified and is then made available through SMA connectors. Below, is a summary of the specifications of the unit, however variants of this design are possible, please contact Farran Technology for details.

> Downconverters

>> Custom Designs

> Typical Electrical Specifications

Model BDC-28 IRS	
RF Frequency Range(GHz)	34.5 – 35.5 GHz
LO Frequency Range	34.44 - 35.56 GHz
IF Frequency	60 MHz
LO Level	+2 dBm min.
Noise Figure	6 dB max
Input Waveguide	WR-28 UG599/U
IF Port	SMA-F



Typical Outline Drawing (Model BDC-28 IRS)

> How To Order

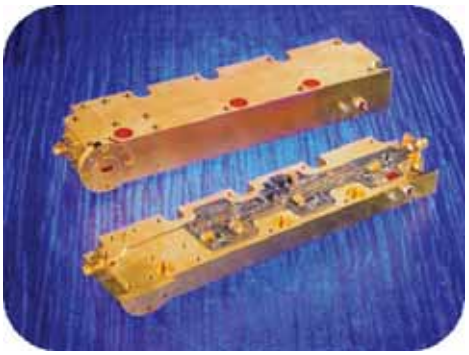
Please specify specifications of the model BDC IRS.
Customer requirements can be accommodated.

> Upconverters

>> Custom Designs

Features

- High RF Power
- Very Low Spurious Level
- Integrated LO multiplier
- Integrated LO PLDRO Option
- Integrated LO synthesizer Option



Model BUC-22S

Applications

- Communications
- Radar Front-ends
- Test Instrumentation
- Frequency Extension

Description

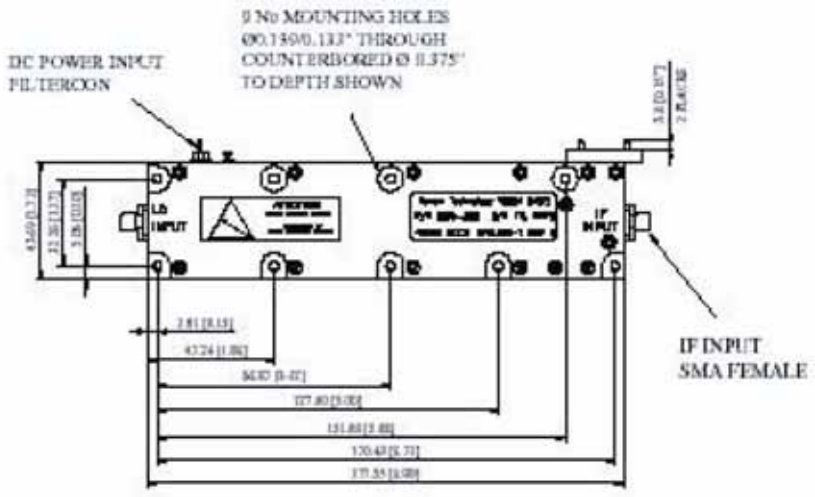
This Q-band MMIC-based block upconverter accepts intermediate frequencies (IF) of 6.4 – 7.4 GHz. The local oscillator (LO) signal is approximately 1.3 GHz. The unit upconverts the IF signal to the band 43.5 – 45.5 GHz. The scheme used for LO frequency multiplication is a times seven step-recovery diode multiplier followed by a MMIC quadrupler. A proprietary MMIC Schottky-diode based balanced mixer is utilized as an upconverter. Following upconversion, the radio frequency (RF) signal is amplified and passed through a microstrip-to-ridge waveguide transition and waveguide high-pass filter. The unit features extensive filtering to provide a very clean output signal with low spurious response. Above is a summary of the specifications of the unit. Variants of this design are possible; please contact Farran Technology for details.

> Upconverters

>> Custom Designs

> Typical Electrical Specifications

Model BUC–22S	
RF Frequency Range (GHz)	43.5 - 45.5 GHz
LO Frequency Range	9.275 - 9.531 GHz
LO Level	+27 dBm min.
Input Frequency (GHz)	6.40 – 7.44 GHz
Input Waveguide	WR – 22 UG383/U
Input Level	-20 to +15 dBm
IF Port	SMA - F



Typical Outline Drawing (Model BUC-22S)

> How To Order

Please specify specifications of the model BUC-22S.
Customer requirements can be accommodated.

MMIC Amplifiers

MM-wave Low Noise Amplifiers

Features

- Low noise figure
- Up to full waveguide bandwidth
- Single power supply
- Compact size, light weight
- Wide operation temperature range

Model FLNA - 15

Applications

- Communication receivers
- Radar front ends
- Wideband radiometry
- Transceiver sub-assemblies

Description

FLNA series low noise amplifiers are constructed with discrete or MMIC PHEMT devices that operate at the frequency range from 18 to 96 GHz. These amplifiers are especially designed for low noise applications. The amplifiers are offered in two categories, namely, standard and custom build. The custom built amplifiers are offered in various RF interfaces, including standard waveguide or coax connectors, for convenient system integration. Optional input and output integrated isolators are available to further improve the port return loss.

> MM-wave Low noise Amplifiers

> FLNA series Specifications

Model	Freq. (GHz)	BW (GHz)	NF (dB, Max)	Gain	V/I (V/mA)	VSWR (Typ)
FLNA-42-15	18.0-26.5	8.5	3.5	15	8/100	2 :1
FLNA-42-30	18.0-26.5	8.5	3.5	30	8/200	2 :1
FLNA-28-20	26.5-40	13.5	4.0	20	8/100	2 :1
FLNA-28-30	26.5-40	13.5	4.0	30	8/200	2 :1
FLNA-15-15	57.0-65.0	8.0	6.0	15	8/100	2 :1
FLNA-10-15	92.0-96.0	4.0	6.0	15	8/50	2 :1
FLNA-10-30	92.0-96.0	4.0	6.0	30	8/100	2 :1

> Custom Amplifiers

Note:
As well as the standard products listed above, which provide the specified performance over the full bandwidth indicated, Farran Technology also offers customized solutions for specific application requirements. Improved performance may be available over narrower bandwidths depending on chip availability. Additional gain can also be provided by cascading stages.

Please specify your preferred connectors with your request.
Please contact our sales representatives with your specific Requirements.

Specifications subject to change without notice.

MM-wave Driver Amplifier

Model FPA 22-40-30

Applications

- Driver amplifier
- Base Station TX
- Instrumentation
- Point to point comms.

Description

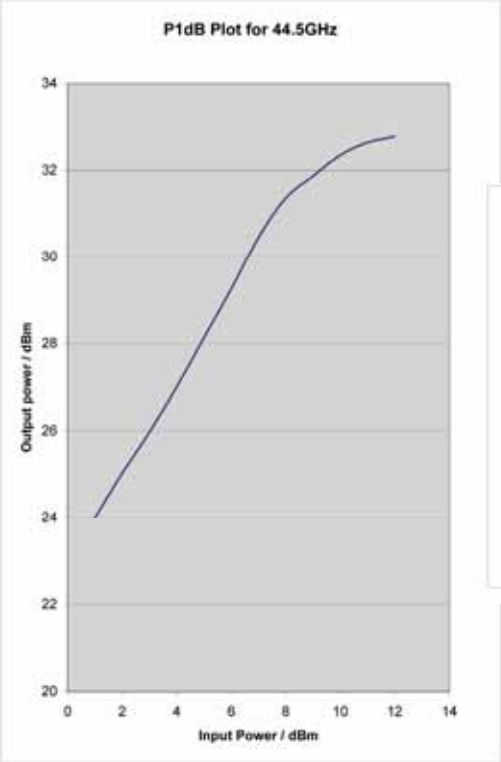
A general purpose 1 watt cw power amplifier in the 43-46 GHz frequency range.

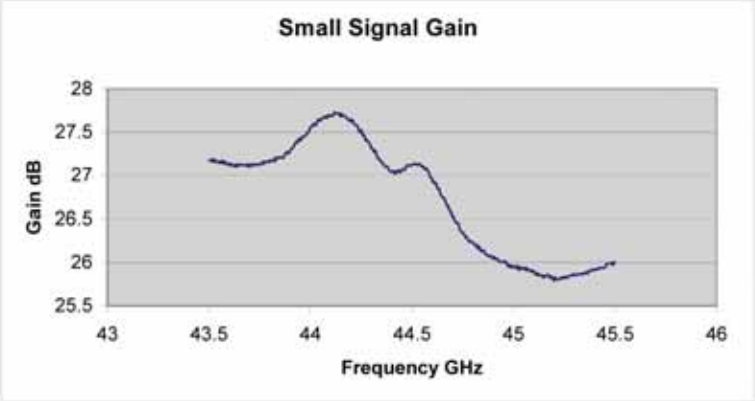
The unit is used with a heatsink.

> MM-wave Driver Amplifier

>> FPA 22-40-30 Specification

Product features	Min	Typ	Max	Unit
RF Frequency	43		46	GHz
Linear Gain	25	27		dB
Psat		33		dBm
P1dB	30	31		dBm
Supply Voltage	+7	+8	+9	V
Supply Current		4600		mA
Connectors	Input	2.4 mm	Output	WR-22





> Custom Amplifiers

If you have a requirement for a similar type product with specification differences then please consult the factory.

MM-wave Power Amplifiers

Features

- High output power and IP3
- Up to full waveguide bandwidth
- Single power supply
- Compact size, light weight
- Wide operation temperature range

FPA – 42S : Custom 2W Power Amp.

Applications

- Communication transmitters
- Radar front ends
- Power block for multiplier chains
- Transceiver sub-assemblies

Description

FPA series high power amplifiers are discrete and/or MMIC PHEMT device based amplifiers that operate at the frequency range between 18 to 96 GHz for high output power applications. The amplifiers are offered in two categories, namely, standard and custom build. The customer build amplifiers are offered in various RF interfaces, including standard waveguide or coax connectors, for convenient system integration. The optional input and output integrated isolators are available to further improve the port return loss.

> MM-wave Power Amplifiers

> FPA series Specifications

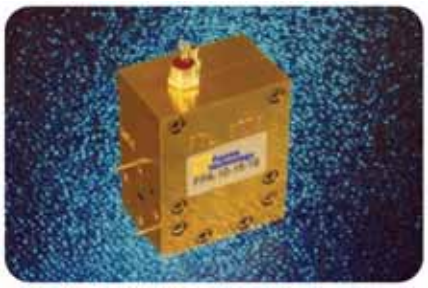
Model	Freq. (GHz)	BW (GHz)	P-1 (dB, Min)	Gain(dB)	V/I (V/mA)	VSWR (Typ)
FPA-42-22-28	18.0-26.5	8.5	28	25	8/550	2 :1
FPA-28-30-29	27.0-32.0	5.0	29	25	8/650	2 :1
FPA-28-34-30	32.0-36.0	4.0	30	25	8/1100	2 :1
FPA-28-38-30	36.0-40.0	4.0	30	25	8/900	2 :1
FPA-22-41-22	37.0-45.0	8.0	22	20	8/500	2 :1
FPA-22-42-26	40.0-44.0	4.0	26	25	8/1500	2 :1
FPA-15-60-16	55.0-65.0	10.0	16	25	8/200	2 :1
FPA-10-16-19	92.0-98.0	6.0	16	16	8/200	2 :1
FPA-10-19-21	92.0-98.0	6.0	18	19	8/400	2 :1

> Custom Amplifiers

Note:
As well as the standard products listed above, which provide the specified performance over the full bandwidth indicated, Farran Technology also offers customized solutions for specific application requirements. Improved performance may be available over narrower bandwidths depending on chip availability (e.g. 35 - 40 GHz: Gmin 12.5dB, P1dB 20dBm; or 36 - 37 GHz: Gmin 24dB, Power 2W). Additional gain can also be provided by cascading stages. Waveguide I/O is also offered as an option. Please contact our sales office with your specific requirements.

> MM-wave Power Amplifiers

>> FPA-10-16-19
92-98 GHz Amplifier



Applications

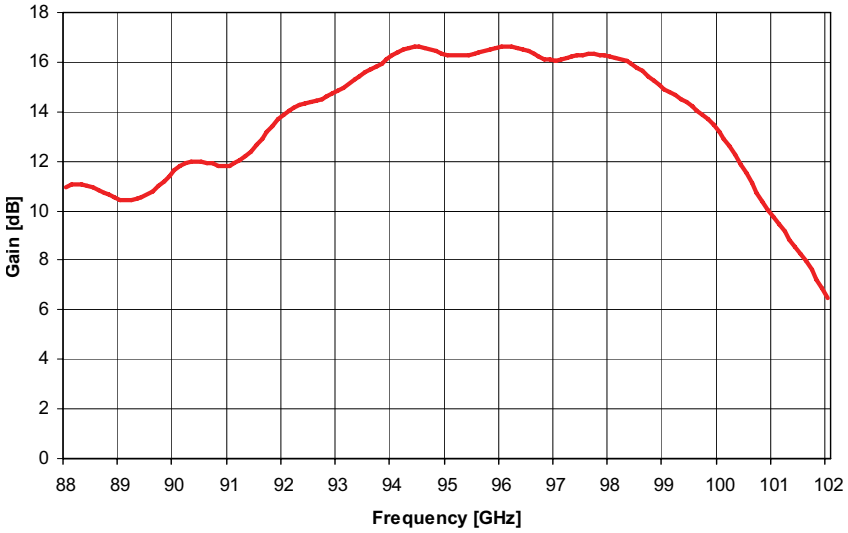
- Driver amplifier
- Sensors
- Instrumentation
- Imaging range

Description

A general purpose MMIC packaged driver amplifier in the W-band frequency range. further improve the port return loss.

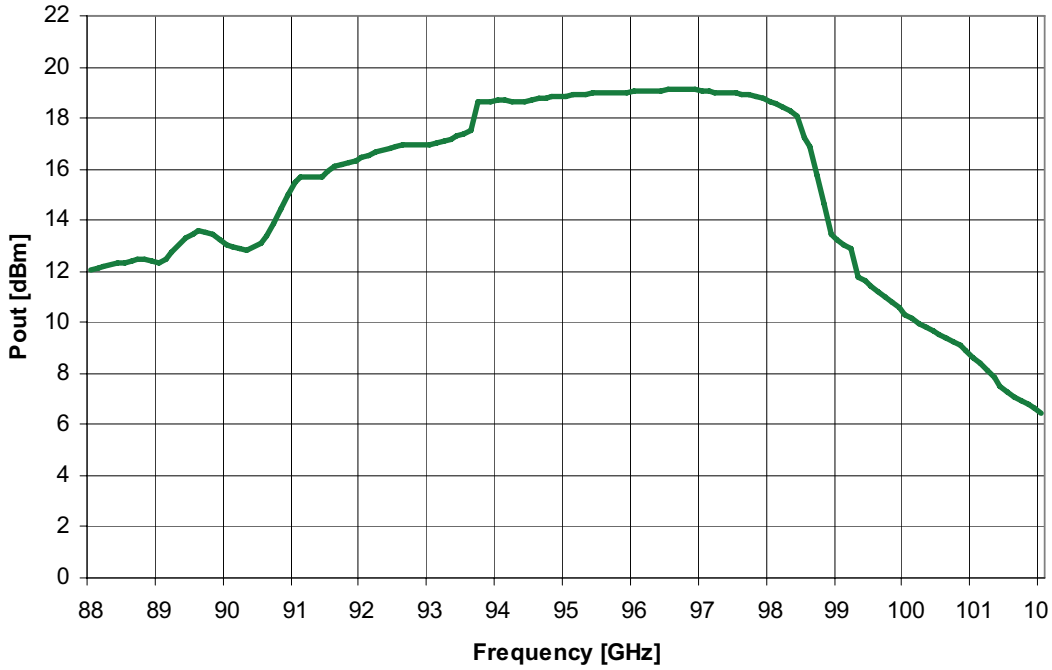
Features

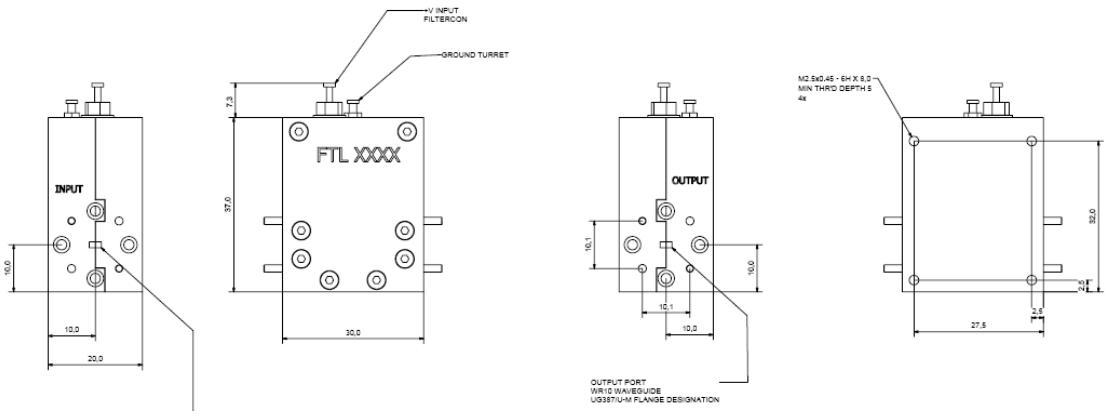
Product features	Min	Typ	Max	Unit
RF Frequency	92		98	GHz
Linear Gain		16		dB
Psat		19		dBm
P1dB		16		dBm
Input Drive Level			7	dBm
Supply Voltage	4.5	5	8	V
Current		200		mA



> MM-wave Power Amplifiers

>> FPA-10-16-19
92-98 GHz Amplifier





Note :
The data presented in this document describes new products in the pre-production phase of development, and is for information only. Farran Technology reserves the right to change, without notice, the characteristic data and other specifications applied to this product. The product may be subject to Irish export restrictions.

> MM-wave Power Amplifiers

>> FPA-10-19-21
92-98 GHz Amplifier

Description

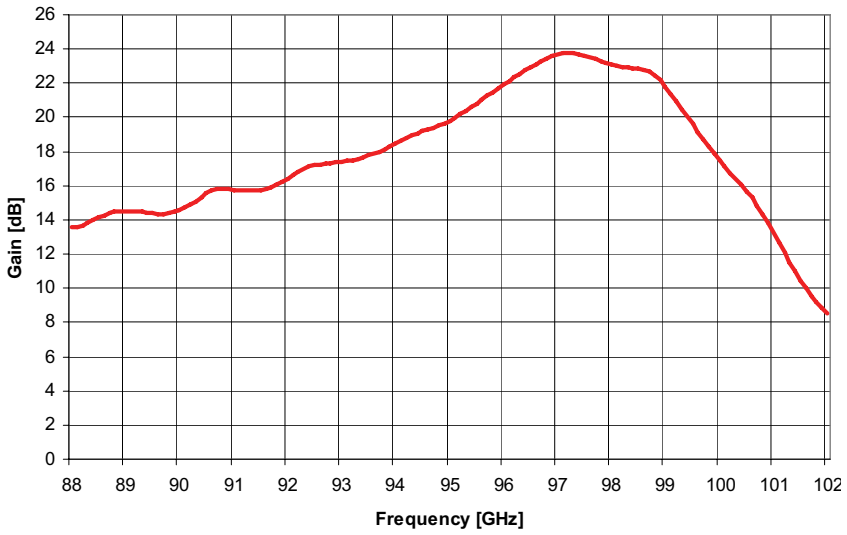
A general purpose MMIC packaged driver amplifier in the W-band frequency range.

Applications

- Driver amplifier
- Sensors
- Instrumentation
- Imaging

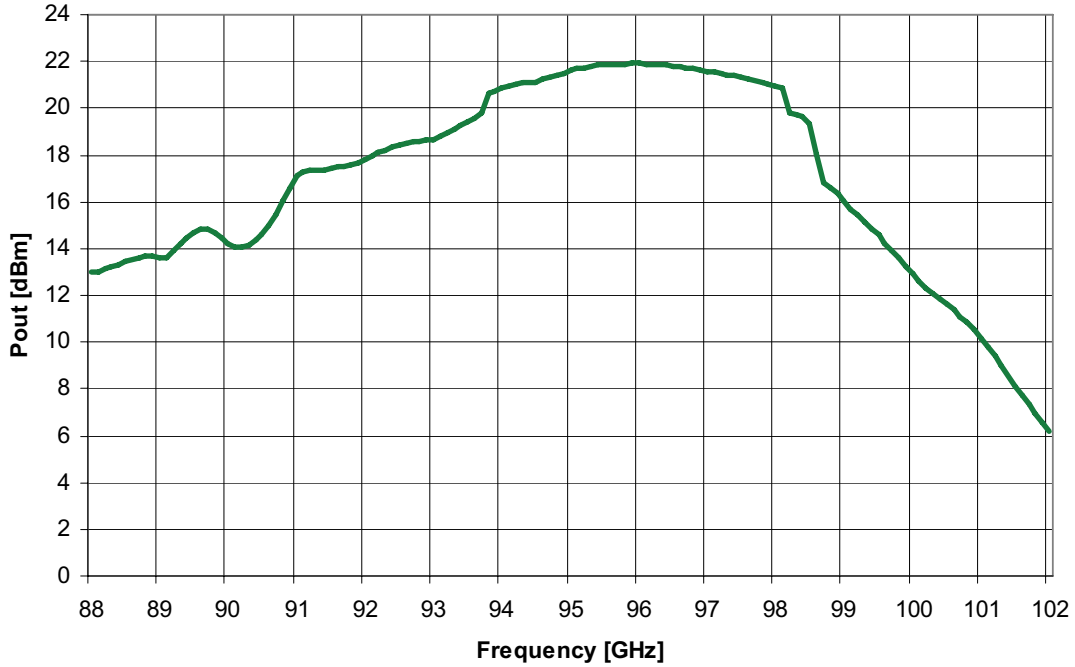
Features

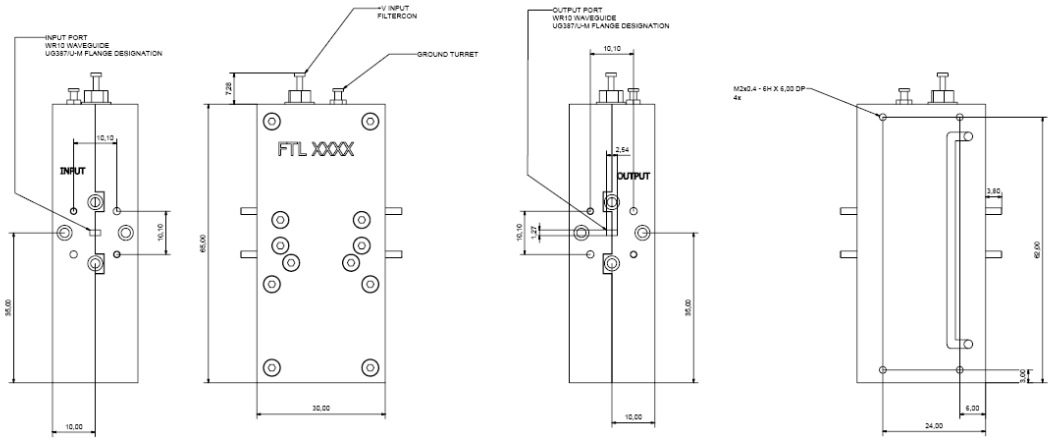
Product features	Min	Typ	Max	Unit
RF Frequency	92		98	GHz
Linear Gain		19	23	dB
Psat		21		dBm
P1dB		18		dBm
Input Drive Level			9	dBm
Supply Voltage	4.5	5	8	V
Current		400		mA



> MM-wave Power Amplifiers

>> FPA-10-19-21
92-98 GHz Amplifier





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Submillimeter Components

Corner Cube Submillimeter Detectors SERIES CD

Features

- High Sensitivity
- Mechanically Rugged
- Optional Built-in Video Network
- Built-in Protection Diode and Shorting Switch

CDS Corner Cube Detector

Applications

- Plasma Diagnostics
- Radiation Monitoring
- Video Detection

Description

Farran Technology produces a complete range of corner cube detectors for use in the submillimeter wavelength region. The corner cube detector consists of a long wire antenna, backed by a corner cube reflector, contacting a low capacitance Schottky barrier diode. This configuration has been recognised as being that providing the most sensitive and broadband response to radiation at submillimeter wavelengths.

Farran Technology is in a unique position to supply high quality corner cube detectors as it also manufactures in-house the low noise diodes whose performance is the key to high sensitivity in this wavelength region. All corner cubes supplied by FTL are mechanically rugged units and each incorporates a shorting switch to provide protection from static discharges when it is not being used. A built-in protection diode reduces the risk of burnout from transients when the detector is in use.

Each corner cube detector is custom made for the frequency specified by the customer. The corresponding wavelength determines the length of the antenna in the corner cube as well as the parameters of the Schottky diode to be used.

The corner cube detectors are intended for video detection of a modulated source. There are two separate ports, one video output connector and one DC-bias input connector. The standard video output frequency is 10 KHz to 100 MHz, but can be ordered to customer's specification. The detectors have a built-in video matching network to ensure that the highest sensitivity is achieved within the video frequency band.

> Corner Cube Submillimeter Detectors SERIES CD

> Typical Electrical Specifications

In order to achieve the highest sensitivity, the detectors require a DC-bias for the Schottky barrier diode. The DC-bias network is an integral part of the video matching network and is supplied via a separate DC-bias input connector. The Farran Technology Precision DC-Bias Supply FDB-F4 is recommended to ensure safe provision of suitable bias voltage. The corner cube detectors have a 24° (at 10dB points) Gaussian beam at an angle of 28° to the vertical, see Figure 1. This beam must be collimated by a lens or mirror to match the customer's system requirements. Contact Farran for further details. The corner cube detectors are manufactured in two different configurations:

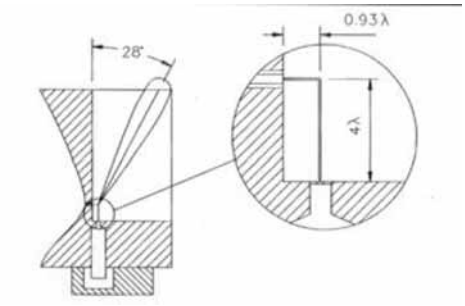


Figure 1. The corner cube detectors have a 24° wide (at 10dB points) Gaussian beam at an angle of 28° to the vertical.

• Option CDS. See Figure 2. Standard model with integral shorting switch and protection diode. Without video matching network. Single output connector. Economical model for power detection, suitable for customer's own back-end applications.

• Option CDB. Similar features to CDS but also including a video network. Separate DC-bias and video ports. Standard video output is 10 KHz - 100 MHz.

●●● QUASI OPTICAL DETECTORS, Specifications

Multiplier	Frequency (GHz)	Wavelength (mm)	Typical video NEP[1)] W/Hz$^{1/2}$	Typical Responsivity (V/W)	Max. Input Power (mW)
CD (X)-1	300-600	1.0-0.5	<10^{-9}	200	60
CD (X)-2	600-800	0.5-0.4	2x10^{-9}	100	50
CD (X)-3	800-1000	0.4-0.3	3x10^{-9}	50	40
CD (X)-4	1000-2000	0.3-0.15	5x10^{-9}	20	30
CD (X)-5	2000-3000	0.15-0.10	<10^{-8}	15	30

> Corner Cube Submillimeter Detectors SERIES CD

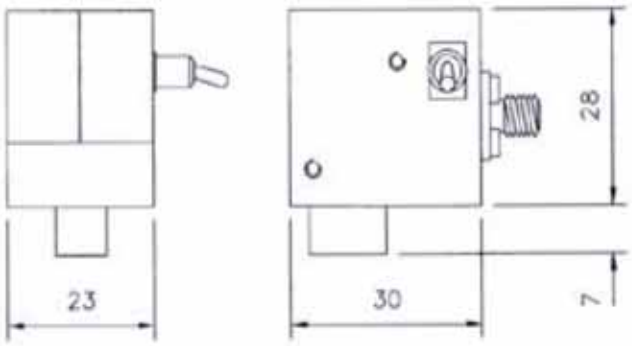


Figure 2. CDS Corner Cube Detector

> Recontactability

These detectors have been constructed to be mechanically robust and to provide trouble-free operation if they are handled with reasonable care. However, in common with all whisker-contacted structures they can be accidentally damaged. Provided that the whisker tip is not deformed they can be recontacted on site by the customer. Full details are available in our application note AN50. Farran Technology also provides a fast turnaround time on recontacting or whisker replacement for units which are returned to the factory.

Corner Cube Submillimeter Mixers SERIES CM

Features

- High Sensitivity
- Built-in IF Matching Network
- Mechanically Rugged
- Built-in Protection Diode and Shorting Switch

Corner Cube Mixer Model CMB-3

Application

- Radio Astronomy
- Plasma Diagnostics
- Atmospheric Sounding
- Laboratory Spectroscopy

Description

Farran Technology produces a complete range of corner cube mixers for use in the submillimeter wavelength region. The corner cube mixer consists of a long wire antenna, backed by a corner cube reflector, contacting a low capacitance Schottky barrier diode. This configuration has been recognised as being that providing the most sensitive and broadband response to radiation at submillimeter wavelengths.

Farran Technology is in a unique position to supply high quality corner cubes as it also manufactures in-house the low noise diodes whose performance is the key to high sensitivity in this wavelength region. All corner cubes supplied by FTL are mechanically rugged units and each incorporates a shorting switch to provide protection to the unit from static discharges when it is not being used. A built-in protection diode reduces the risk of burnout from transients when the mixer is in use.

Each corner cube mixer is custom made for the frequency specified by the customer. The corresponding wavelength determines the length of antenna in the corner cubes as well as the parameters of the Schottky diode to be used. In this way, our customers can be confident that the corner cube they are purchasing has been customized specially for their applications.

Corner Cube Submillimeter Mixers SERIES CM

Description

The corner cube mixers are intended for heterodyne reception with a local oscillator (LO). The output signal from the mixer is at an intermediate frequency (IF) in a specific IF bandwidth. The mixers have a built-in IF matching network to ensure that the highest sensitivity is achieved. The IF output impedance is 50 ohm. It is important that the customer specifies the IF centre frequency and IF bandwidth:

(a) IF centre frequency range: 0.5GHz to 15GHz as standard.
(b) IF bandwidth range: 100MHz to 1000MHz as standard.

The corner cube mixers can be ordered with fixed tuned corner reflector, model CMB, or with tunable corner reflector, model CMT. The standard FTL corner cube model CMB has the antenna structure optimized for a particular operating frequency, since the contacting whisker is located a fixed distance from the apex of the 90 degree back reflector.
Although the bandwidth of this device is rather broad, for applications where sensitivity is important there is a substantial improvement to be obtained by making the position of the 90 degree reflector adjustable with respect to the whisker.

This ensures that at any frequency other than the design frequency, the correct ratio of the whisker length to whisker spacing can be guaranteed and thus the performance optimized. The tunable corner cube mixers CMT have the same centre frequency specifications as for the CMB models with fixed corner reflector. They include an IF-matching network with integral DC-bias port and safety switch with protection diode.

The corner cube mixers require a DC-bias for the diode in order to achieve the lowest conversion loss. The DC-bias network is an integral part of the IF matching network and is supplied via a separate DC-bias input connector. The Farran Technology Precision DC Bias Supply FDB-F4 is recommended to ensure maximum safe operation.

The corner cube mixers have a 24° wide (at 10dB points) Gaussian beam at an angle of 28° to the vertical, see Figure 2 in the following page. This beam must be collimated by a lens or mirror to match the customer's system requirements. Contact Farran for further details.

> Corner Cube Submillimeter Mixers SERIES CM

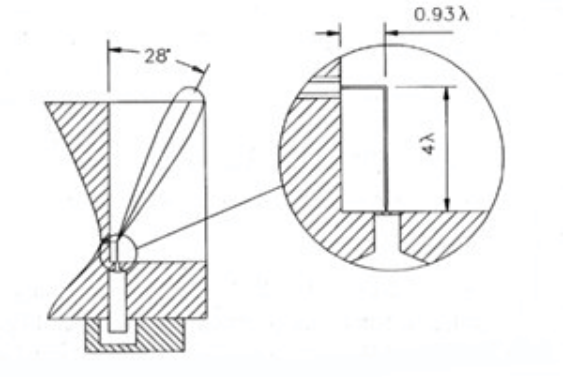


Figure 2. Corner Cube Mixer have 24° wide (at 10dB points) Gaussian beam at an angle of 28° to the vertical

> Specifications – Quasi - Optical Mixers

Model	Frequency (GHz)	Wavelength (mm)	Tyo/ Max DSB Conversion Loss (dB)	Room Temp. (295K)		
				Typical DSB Noise Temp. (K2)	LO Power (mW)	DSB NEP (W/H)
CM (X)-1	300-600	1.0-0.5	9/12	3000	5	$4x10^{-20}$
CM (X)-2	600-800	0.5-0.4	12/14	7500	7	$1x10^{-19}$
CM (X)-3	800-1000	0.4-0.3	14/16	10000	10	$1.5x10^{-19}$
CM (X)-4	1000-2000	0.3-0.15	16/18	20000	15	$3x10^{-19}$
CM (X)-5	2000-3000	0.15-0.10	18/20	40000	30	$6x10^{-19}$

Notes:

X=B: Fixed tuned;

X=T: Tunable reflector

IF=1.2 - 1.4 GHz;

T (IF)=100k

Quasi-Optical Harmonic Mixers SERIES CHM

Features

- Standard Waveguide Input for LO
- Backshort Tuning on LO Input
- Corner Cube Wire Antenna for RF
- Broadband Low Loss RF Operation
- GaAs Schottky Barrier Diode for Optimum Performance

Model CHM-2/WR15

Applications

- Frequency Metrology
- Gaseous Spectroscopy
- Tunable FIR Sources

Description

There are many applications where submillimeter wavelength mixers are required and where the signal/noise ratio or the conversion loss requirements are such that expensive fundamental mixers/LO sources are not required.
Farran Technology now has available a range of harmonic mixers specifically designed for submillimeter wavelength applications. The photograph shows a harmonic mixer designed for an LO frequency of 100 GHz and an RF frequency of 1500 GHz. The input LO power is via a waveguide built into the ground plane of the corner cube structure while RF input is via the corner cube antenna.
The diode chip is contacted by the whisker antenna and is located in the waveguide so that a tunable backshort can be used to independently couple the 100 GHz radiation into the mixer diode. This structure combines waveguide and optical techniques in a compact reliable structure which makes optimum use of both technologies.
In the submillimeter region where LO power is generally scarce and expensive, this harmonic mixer structure is an excellent low-cost solution for extending the frequency capabilities of your laboratory, with obvious benefits in frequency metrology, plasma diagnostics, etc.

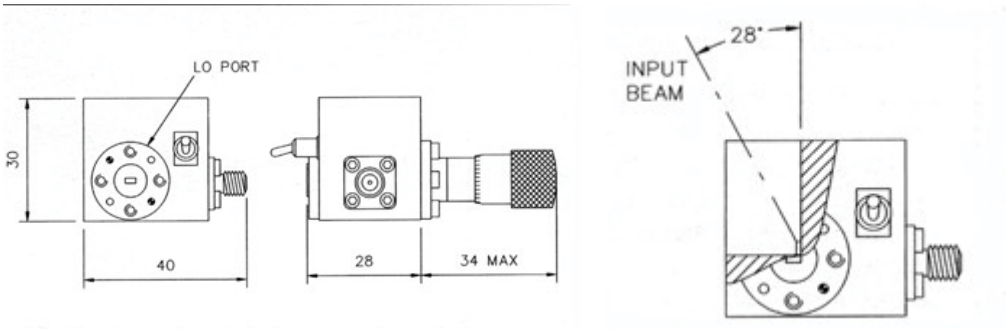
> Quasi-Optical Harmonic Mixers SERIES CHM

> Typical Electrical Specifications

●●● QUASI-OPTICAL HARMONIC MIXERS

Model	CHM-1			CHM-2		CHM-3	
RF (GHz)	300-600			600-800		800-1000	
LO Frequency (GHz)	75-110	60-90	50-75	75-110	60-90	75-110	60-90
LO WG Size WR-	10	12	15	10	12	10	12
LO Flange Compatability	387/U-M	387/U	385/U	387/U-M	387/U	387/U-M	387/U
Harmonic No.	5	6	7	8	9	10	12
LO Power Required (mW)	5	5	5	10	10	15	15
Typ. S/N* (dB)	53	50	47	47	43	43	40
Conversion Loss (dB)	35	40	45	45	50	50	55
NEP (W/Hz)	$5x10^{-14}$	10^{-13}	$2x10^{-13}$	$2x10^{-13}$	$5x10^{-13}$	$5x10^{-13}$	10^{-12}

* Assuming a 1 mW RF available and S/N measured into 100 KHz bandwidth.



Corner Cube Mixer CHM-N

We will also be happy to quote for similar harmonic mixer structures operating at RF's up to 3000GHz. Please contact us at sales@farran.com for full specifications quoting the following Model Numbers:

Model	CHM-4	CHM-5
LO frequency (GHz)	75 - 110	75 - 110
RF (GHz)	1000 - 2000	2000 - 3000

> Quasi-Optical Harmonic Mixers SERIES CHM

Pump Coupling

We recommend the use of flexible waveguide into the pump port. This will give positional flexibility which will be advantageous in setting up the optical alignment correctly.

Optical Coupling

It is essential that correct coupling is made to the RF port. The input beam should have a 10dB full beam width of 24 degrees. This corresponds to a F / D No. of 4.3 to the 3dB points. The beam waist should be located at the whisker tip. Contact Farran for further details.

Recontactibility

These mixers have been constructed to be mechanically robust and to provide trouble-free operation if they are handled with reasonable care. However, in common with all whisker-contacted structures they can be accidentally damaged. Provided that the whisker tip is not deformed they can be recontacted on site by the customer. Full details are available in our application note AN50.
Farran Technology also provides a fast turnaround time on recontacting or whisker replacement for units which are returned to the factory.

New Model

Using a coaxial input K connector for the LO pump input, Farran Technology have developed a 26.5 - 40 GHz coaxial LO port version of its FIR harmonic mixer. Contact us at **sales@farran.com** for further details.

> How To Order

CHM - N / WR – NN

RF Band LO Band

Example :

A harmonic mixer designed for operation at 680 GHz with LO at 90 GHz would be either:

- CHM – 2/WR – 12
- CHM – 2/WR – 10

Depending upon the waveguide size required.

Applications

> INTRODUCTION

In addition to Farran's extensive range of millimeter wave components a major part of our activity is based around developing application focused components and sub systems. We work with our customers to develop their systems and can provide engineering input to ensure optimum performance and solutions for cost effective manufacturability.

This section shows a selection of specialist products which have been derived from such specific customer applications.

> Frequency Extension

>> VNA Frequency Extension

> Applications

- VNA frequency extension unit
- Use with:
  Agilent E836XA/B/C PNA and PNA-X
  R & S ZVA VNA
  Anritsu 37XXXD Lightning and VectorStar

> Description

Farran Technology Ltd. offers frequency extender modules for customer owned VNA's to extend their measurement capability to 170 GHz. They are designed to cover 5 waveguide bands, with ongoing development on higher frequency band modules. These are available as T/R and T modules. The test system requirement is a 4 port VNA, equipped with a millimetre wave test set, an input IF signal frequency between 10 and 300 MHz, and two synthesized generators, covering up to 20 GHz, for the RF and LO signals.
There are two possible configurations of the measurement setup using the Farran mm-wave modules, T/R – T/R and T/R – T. The first configuration provides the capability of a full two-port S-parameter measurement and consists of two identical transmission/reflection modules. The second configuration enables measurement of only transmission (S_{21}), and input reflection coefficient (S_{11}), of the DUT simultaneouslv.

Mm-wave extender models

Table 1 gives frequency extender models with waveguide band designation.

> Frequency Extension

>> VNA Frequency Extension

Model Number	Type	Frequency Range	Waveguide Designation
FEV-19-T	Transmission	40 – 60 GHz	WR-19
FEV-15-T	Transmission	50 – 75 GHz	WR-15
FEV-12-T	Transmission	60 – 90 GHz	WR-12
FEV-10-T	Transmission	75 – 110 GHz	WR-10
FEV-8-T*	Transmission	90 – 140 GHz	WR-8
FEV-6-T*	Transmission	110 – 170 GHz	WR-6
FEV-19-TR	Transmission/Reflection	40 – 60 GHz	WR-19
FEV-15-TR	Transmission/Reflection	50 – 75 GHz	WR-15
FEV-12-TR	Transmission/Reflection	60 – 90 GHz	WR-12
FEV-10-TR	Transmission/Reflection	75 – 110 GHz	WR-10
FEV-8-TR*	Transmission/Reflection	90 – 140 GHz	WR-8
FEV-6-TR*	Transmission/Reflection	110 – 170 GHz	WR-6
FEC-01	Control Box for Anritsu Solution		
FEC-02	Control Box for Agilent Solution		
FEK – xx	Calibration kit	Only sold with above heads	

Table 1. Mm-wave extender modules.

System Operation

The Farran transmission/reflection module is driven by RF and LO signals from the compatible VNA, with mm-wave option. In the T/R module the RF signal is amplified, multiplied and applied to a dual directional coupler. The through path of the coupler is connected to the test port and the signal is transmitted to the DUT. A portion of the transmitted signal is coupled back to the harmonic mixer, driven by the LO. The mixing product is sent to REF IF output. The reflected signal from the DUT is coupled through the other coupled port of the coupler and used as a RF input for the second harmonic mixer, where Test IF signal is generated. The REF and TEST IF signals are compared in phase and amplitude in the VNA to produce results for S11. The transmitted signal through the DUT is received by the other module and is coupled to the harmonic mixer. This again is compared in phase and amplitude to the REF signal to produce results for S21. A similar scenario occurs in the other module of the pair, to produce results for S22 and S12, enabling quick and accurate full two port S-parameter measurement.

In the configuration with T/R and T only forward transmission coefficient and input reflection coefficient can be measured simultaneously. To obtain a full two port S-parameter measurement step the DUT is reversed and measurement repeated.

> Frequency Extension

>> VNA Frequency Extension

Interface	5 SMA (F)
Power requirement	12 – 15 V (DC) @ 2A
Operating Temperature Range	20 – 30 ° C
Approximate Dimensions L x W x H [mm]	350 x 250 x 100

Table 2. General specifications.

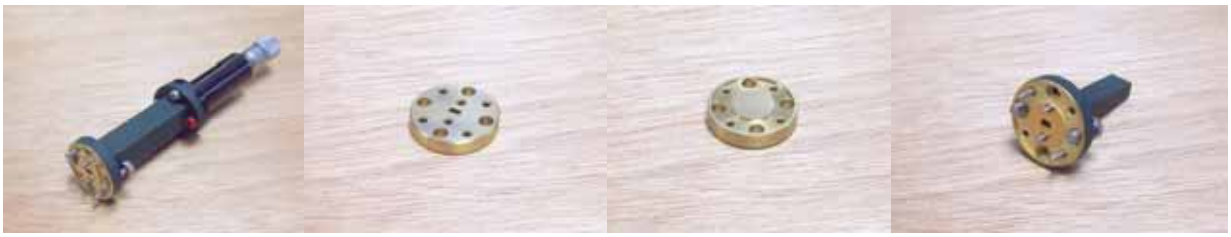
Waveguide designation	U – band (WR-19)	V – band (WR-15)	E – band (WR-12)	W – band (WR-10)	F – band* (WR-8)	D – band* (WR-6)
Model Number	FEV - 19	FEV - 15	FEV - 12	FEV - 10	FEV - 8	FEV - 6
Frequency Range [GHz]	40 - 60	50 - 75	60 - 90	75 - 110	90 - 140	110 - 170
RF Frequency [GHz]	10 - 15	12.5 – 18.8	10 - 15	12.5 – 18.8	11.25 – 17.5	11 – 17
RF Harmonic Number	4	4	6	6	8	10
LO Frequency ± IF offset [GHz]	10 - 15	10 - 15	10 - 15	9.4 – 13.75	11.25 – 17.5	9.1 – 14.2
LO Harmonic Number	4	5	6	8	8	12
IF Frequency [MHz]	10 -300	10 -300	10 -300	10 -300	10 -300	10 -300
Dynamic Range [dB]	>105	>100	>97	>94	>80	70dB typ
Power at DUT input [dBm] (typical)	+7	+5	+2	0	-8	-20

Table 3. System Specifications.

*Preliminary product, specification subject to change without notice.

- The customer shall provide RF interface cables and calibration kit. On special request, however, Farran Technology Ltd. will provide suitable cable interface and cal kit.
-

Calibration Kits



Sliding Load | Shims | Flush Short | Fixed termination

> Frequency Extension

>> Spectrum Analyser Extension

Figure 1: WHMB-15 Harmonic Mixer

> Applications

- Spectrum Analysis Frequency Extension

> Description

A harmonic mixer is another term for a sub-harmonic mixer (SHM) but is more commonly used for systems using higher multiples of the input local oscillator (LO) to produce the mixing LO. They lend themselves well at higher frequencies when it can be difficult to produce a suitable LO signal. For example, tuning range and output power become more difficult to achieve at higher frequencies, whilst the cost invariably increases.

Farran Technology's Harmonic Mixer series covers four bands from 40GHz to 110GHz and are 2-port balanced harmonic mixers.

> Features

Model	WHMB-19	WHMB-15	WHMB-12	WHMB-10
Frequency Range(GHz)	40-60	50-75	60-90	75-110
LO Frequency Range (GHz)	10-15.2	8-13	10-15.2	9.4-14
Conversion Loss Typ* (dB)	20	25	32	38
Max Input Power (mW)	10	10	10	10
Max LO Level (dBm)	18	18	18	18
Waveguide Size	WR 19	WR 15	WR 12	WR 10
Waveguide Flange Compatability	UG383/U-M	UG385/U	UG387/U	UG387/U-M
Output Connector	SMA-F	SMA-F	SMA-F	SMA-F

*Notes:
Conversion Loss specifications in the table are dependent on LO harmonic number used.

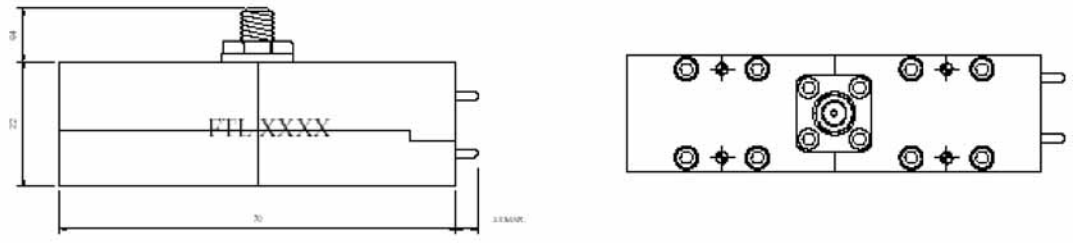


Figure 2: Mechanical Outline of Harmonic Mixer

The balanced harmonic mixer has advantages and disadvantages compared to an unbalanced harmonic mixer. Two significant advantages of the balanced mixer configuration are the suppression of odd LO harmonic mixing products and the elimination of the need for biasing. These result in a cleaner spectrum analyser display making signal identification easier, but an increase in LO power is also required.

Calibration Techniques

Any of the harmonic mixers can be used successfully with a Spectrum Analyser. To preserve quality in the millimetre wave spectrum analysis measurements, it is important to calibrate the combination of spectrum analyser and harmonic mixer at the desired frequency or frequencies of interest. Ideally the user must have a signal source of known amplitude for each frequency to be investigated and a method of power measurement to identify the amplitude of the signals.
In correctly choosing a harmonic mixer for the application, it is necessary to choose one that will cover that harmonic frequency of interest within the mixer's frequency band.

Once a measurable calibration signal has been achieved at the frequency of interest, the signal must be attenuated to a level of less than -20dBm to avoid compression of the harmonic mixer during calibration. It is recommended to use a precision rotary vane attenuator exhibiting full band and very flat response. Such attenuators can be most accurately calibrated with a millimetre wave capable vector network analyser (VNA). Farran Technology manufactures a range of Frequency Extension products to work with a VNA that can be used for this purpose.

An Example using a WHMB-15

The best way to demonstrate the technique is by way of an example. In this case a Farran Technology WHMB-15 Harmonic Mixer is to be used together with the Spectrum Analyser. First of all let's look at the Spectrum Analyser.

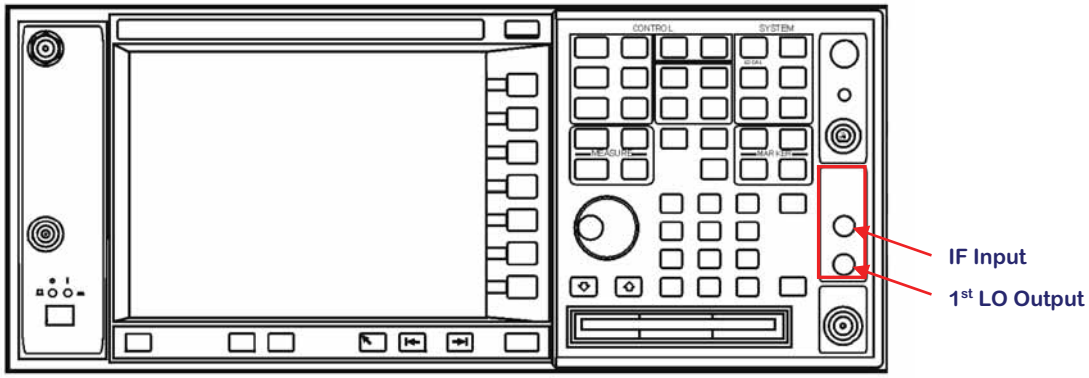


Figure 3: Diagram of Front Panel

The highlighted box shows the IF input and 1st LO output ports of the Spectrum Analyser. Note that these ports (hardware) and associated display functions (software) are only available with IF/LO Option. These are the ports that allow connection for an external mixer. In order to connect a harmonic mixer, a diplexer is required. The purpose of the diplexer is to split the IF out so it can be connected to the IF port and combine the LO on to a single line connected to the mixers LO/IF line. A harmonic of the LO from the Spectrum Analyser mixes with the incoming RF and an IF signal is generated. The IF is low pass filtered in the diplexer and sent to the IF port of the Spectrum Analyser.

The harmonic mixer is typically shipped from the factory with calibration data for a specific harmonic. The calibration data as well as being physically printed on the harmonic mixer is available on a calibration diskette suitable for loading into the Spectrum Analyser disk drive. The Amplitude Correction Factor (mixer conversion loss) can now be loaded and stored and the Amplitude Correction function should be enabled. The system is now ready for measurement.

If it is required that a calibration is required that is based on a different harmonic number then further techniques are described for user calibration of the harmonic mixer.

User Calibration of Harmonic Mixer

The following paragraphs show how a user can calibrate the harmonic mixer when it is required to use perhaps a different harmonic number. Note must be made of the fact that a suitable signal source and power measuring equipment must be available.

The test equipment set-up is defined for the calibration:

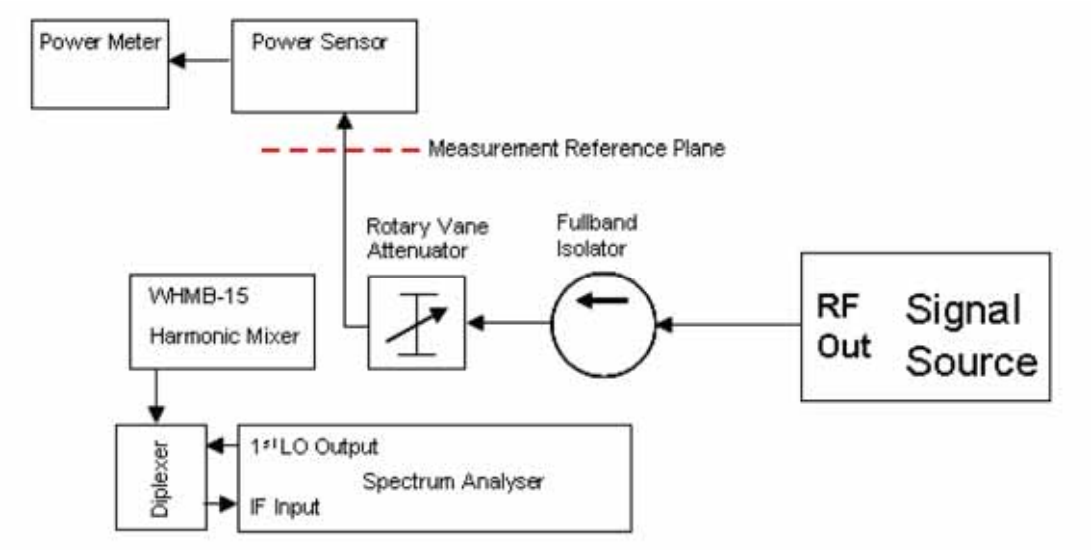


Figure 4: Test Set up for Calibration

After ensuring that the power meter is calibrated for the power sensor at the frequency of interest, adjust the calibrated attenuator to give a predetermined level of -20dBm. Select External Mixer mode on the Spectrum Analyser and Mixer Type to be Unpreselected (the analyser default setting). Next select the external mixer band (in this case 50-75GHz). Load and store the Amplitude Correction Factor (mixer conversion loss – as provided with the mixer) and enable the amplitude correction function. Manually select the harmonic number as required.

Applying the -20dBm calibrated signal to the harmonic mixer, the level of the IF can now be measured on the Spectrum Analyser.

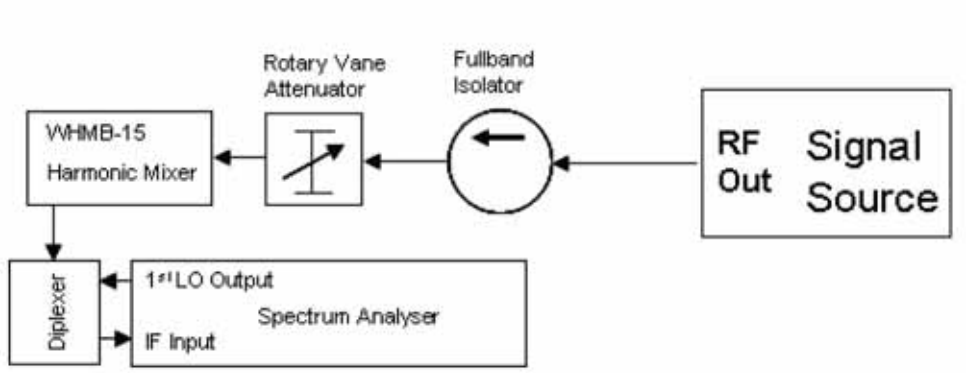


Figure 5: Test Set up for Measurement

Setting the appropriate start (50GHz) and stop (75GHz) frequencies on the analyser, the measurements can begin.
Initial analysis and signal identification is often done at this wide frequency span to find signals whose precise centre frequency is not known and to identify potential interfering signals or unwanted conversion products. After analysis, the span can be made smaller and centred on the frequency of interest.

Using the Signal Identification Features

The Image Shift function method does not remove undesired signals from the measurement but causes them to shift position on alternate sweeps. The desired signal is unaffected and in this way can be easily identified.

The Image Suppress function of the Spectrum Analyser can actually remove undesired signals from the measurement display based on a multilayered function approach similar to that of the Image Shift function.

Conclusion

It can be seen that external mixing in the above described manner offers both a practical and economical solution for frequency extension using spectrum analysers. Attenuation must be paid by the user to correct calibration, set-up and knowledge of uncertainty in the test methodology in order to make meaningful, worthwhile and accurate measurements. This application note has demonstrated basic theoretical and practical examples for applications requiring external mixers.

> Frequency Extension

>> Frequency Extension Sources

Applications

- Test equipment
- Frequency sources

Description

A bench top, solid state multiplier modules to extend frequency range of signal generators (Agilent, Anritsu and R&S).

Features

	Model			
Specification	**FES-19**	**FES-15**	**FES-12**	**FES-10**
Frequency In(GHz)	10 – 15	12.5 – 18.7	10 - 15	12.5 – 18.4
Frequency Out(GHz)	40 - 60	50 - 75	60 - 90	75 - 110
RF In (typ)(dBm)	+ 5			
RF Out (typ)(dBm)	+6	+8	+5	+3
Harmonic Level(dBc)	-20			
RF In VSWR	< 1.5			
RF Out VSWR	< 1.5			
RF In Port	3.5 mm (F)			
RF Out Port	WR-19	WR-15	WR-12	WR-10
DC Supply	12 V @ 1A			
Temperature(°C)	+20 to +30			

> Frequency Extension

>> Frequency Block Converter

> Features

- Low Noise Figure
- Good Spurious Signal Rejection

> Applicat ions

- Channel Surveillance
- Test Equipment
- Communications
- Test instrumentation
- EW & ECM systems

> Description

The FBC-K-xx series is a down-converter for use with 2-20GHz tuned receiver. It is available in 1U 19" rack system.
The FBC-xx-xx series is a down-converter for use as a frequency extender for noise figure measurement test systems. It is available in a 2U 19"rack system. It is also possible to supply a phase locked version of this system for use with tuned receivers or as a frequency stable down-converter.

Standard 1U 19" rack

Standard 2U 19" rack

Part numbering FBC-K-xx series

FBC-K-40-10MHz-40GHz
FBC-K-40-26.5GHz-40GHz
FBC-K-26.5-18GHz-26.5GHz

Part numbering FBC-xx-xx series

FBC-28-40-26.5GHz-40GHz
FBC-22-50-36.5GHz-50GHz
FBC-15-63.5-50GHz-63.5GHz
FBC-15-75-61.5GHz-75GHz
FBC-12-80-66.5GHz-80GHz
FBC-10-88.5-75GHz-88.5GHz
FBC-10-100-86.5GHz-100GHz
FBC-10-110-96.5GHz-110GHz

> Frequency Extension

>> Frequency Block Converter

Typical Specifications

FBC-K-xx	Frequency Range	Max NF (dB)	IF outputs	RF to IF Gain	LO Spurious Signals
FBC-K-40-10MHz...40GHz	Input1 10MHz-20GHz Input2 18GHz-26.5GHz Input3 26.5GHz-40GHz	13	2.5-17GHz	Input1:Straight through Input2,3: 15dB +/-3dB	<-60dBc
FBC-K-40-26.5GHz...40GHz	26.5GHz-40GHz	13	1-18GHz	15dB+/-3dB	<-60dBc
FBC-K-26.5-18GHz...26.5GHz	18GHz-26.5GHz	13	2.5-11GHz	15dB+/-3dB	<-60dBc

FBC-xx-xx	Freq Range (GHz)	NF (dB max, SSb) EIA	LO stability (MHz)	Input Waveguide	Output Connector
FBC-28-40-26.5GHz...40GHz	26.5-40	15	±35	WR28	SMA-F
FBC-22-50-36.5GHz...50GHz	36.5-50	15	±35	WR22	SMA-F
FBC-15-63.5-50GHz...63.5GHz	50-63.5	16.5	±35	WR15	SMA-F
FBC-15-75-61.5GHz...75GHz	61.5-75	10	±35	WR15	SMA-F
FBC-12-80-66.5GHz...80GHz	66.5-80	16	±45	WR12	SMA-F
FBC-10-88.5-75GHz...88.5GHz	75-88.5	18	±50	WR10	SMA-F
FBC-10-100-86.5GHz...100GHz	86.5-100	18	±50	WR10	SMA-F
FBC-10-110-96.5GHz...110GHz	96.5-110	18	±50	WR10	SMA-F

> How To Order

Order as per FBC number above

> Frequency Extension

>> PM-4 - Millimetre Wave and Sub-millimetre Wave Power Meter

> Description

The PM4 is a waveguide dry calorimeter designed to be a primary standard for power measurements throughout the mm to sub-mm range. It is constructed with a waveguide load having a 6 second thermal time constant, and an excellent RF match. A thermal feedback circuit makes the sensor much faster (~0.2 sec TC) for most measurements. A calibration heater resistor is mounted on the load at nearly the same location that most of the input power should be dissipated. Very efficient coupling to the load may be made using standard linear tapers to any smaller waveguide band, and the response is fairly insensitive to the mode content. Input loss is minimized through the use of a very short waveguide. Accuracy may not be verified in the sub-mm using any comparison standard since none exists, but the design is expected to be accurate to within 2%. Comparison between meters in the 100 GHz range shows repeatability within ~1%. Stability and noise have been optimized to permit measurements to 1 µW in a typical lab environment and down to ~0.2 µW in a stable environment. The PM4 is much faster and more accurate than its predecessors, the PM1, PM1B and PM2，PM3

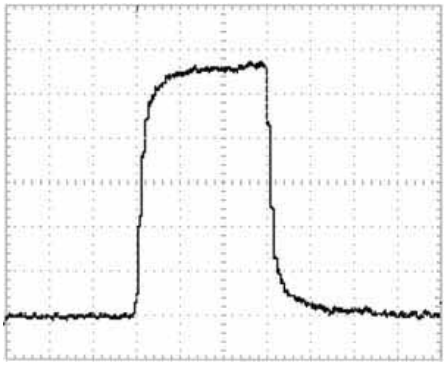
PM-4 Power Meter

PM-4 Sensor

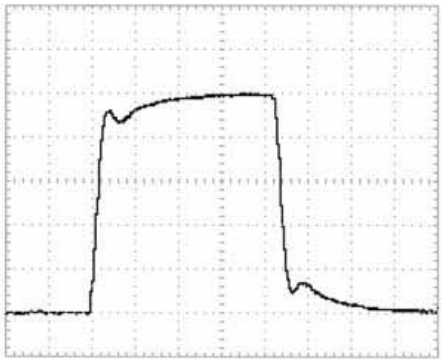
> Frequency Extension

>> PM-4 - Millimetre Wave and Sub-millimetre Wave Power Meter

Scale	Time for 90% Response(s)	Noise(µW rms)
200mW	0.3	5
20mW	0.4	1
2mW	1.2	0.1
200µW	14	0.01



Vertical scale 6uW/div, horizontal 2.5s/div



Vertical scale, 200uW/div,horizontal 0.5s/div

The figures above show the actual response (from analog output) to a 34 µW input on the 2 mW scale (left) and a 1 mW input on the 20 mW scale (right).

Notes

1. Response time is given as the time from application of an input to a response at the analog output of 90% of the final reading. RMS noise is measured at the analog output. Digital meter updates at 2.5 Hz, and adds a flicker of 1 in the last digit.
2. Input is WR10 waveguide (1.25 x 2.5 mm) with UG387 precision flange. Useful frequency response is 75GHz through the submillimeter range, extending even to the visible.
3. Sensor size is 5.1 x 4.8 x 7.6 cm. 1 m cable connects to readout.

> Frequency Extension

>> PM-4 - Millimetre Wave and Sub-millimetre Wave Power Meter

4. 1 kOhm heater resistor (on the RF load) is used for DC calibration. Internal calibration check on all ranges.
5. RF repeatability between meters is better than 1%, and overall calibration better than 2% using DC calibration heater, and known input waveguide loss.
6. Maximum VSWR <1.15:1 from 80-110 GHz (<1.2:1 75-80 GHz). VSWR is expected to be similar or better at frequencies up to 2000 GHz.
7. Input loss is <0.15 dB at 90 GHz.
8. 4 1/2 digit LED panel meter readout, with 4 power ranges. Maximum input power is 200 mW average.
9. Analog output BNC connector on back panel: 0-10V corresponds to 0-FS meter reading.
10. Calibration factor adjustment of up to a factor of 2 using 10 turn knob pot
11. Temperature drift is compensated to <2 µW/°C.
12. The sensor has a thermal time constant (1/e) of 6 seconds. For faster response, the load is heated to a nearly constant temperature using a feedback loop. When input power is applied, the heater power is reduced, and the circuit measures the change, which is equivalent to the input power. The loop gain varies with the power to be measured, changing the response time. For highest sensitivity, no feedback is used on the lowest scale.
13. Changing scales causes a large thermal transient due to the change in bias heat.
14. Switching scales to a lower power (200 mW to 200 µW) requires 15 min for stabilization.
15. Settling time is 2 min when switching scales upward. The 4 1/2 digit display, and the very low noise and high stability, eliminate the need to change scales in most measurements.
16. Operational temperature range 10°-30° C.
17. Required power 105-125 V or 220-240 V 50-60 Hz convertible with jumpers (specify voltage setup). 90-110 V (single voltage) also available.
18. Options at extra cost:
    - Sensor prepared for use in vacuum (operation in vacuum will alter the calibration and other specifications)
    - Transitions to other standard waveguide bands, with estimated calibration: WR8, WR6, WR5, WR4, WR3, WR2.

77GHz FMCW Radar

Features

- Compact, split block construction
- Lightweight and low power
- Configurable to customer specific requirements
- In-house manufacture and test to customer requirements
- TX switching, Diagnostic and BITE
- Demonstrated performance to >100m.

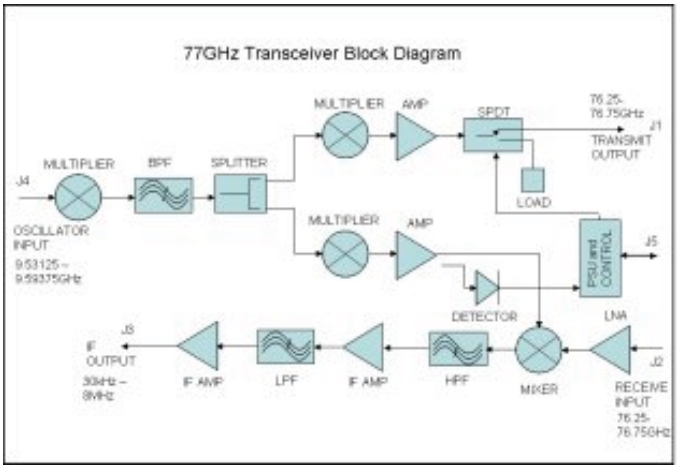
Applications

- Runway FOD detection
- Airport / Apron Traffic monitoring
- Collision Avoidance
- Critical Area Surveillance
- Runway Incursion Detection
- Area Penetration Monitoring

Linearisation Possibilities

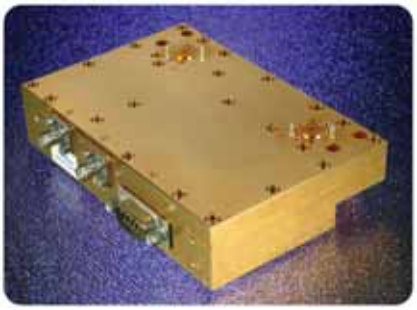
- Active real-time closed-loop linearization (linearity 0.1%)
- Open-loop look-up table linearization (linearity 0.5%)
- General open-loop performance (linearity 5%)

Generic Block Diagram

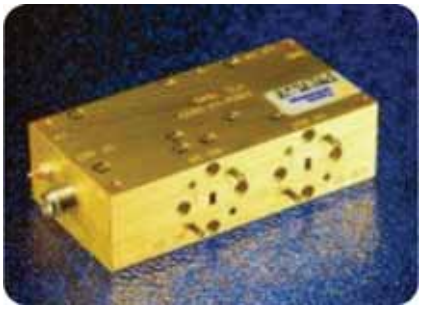


> 77GHz FMCW Radar

Typical Specification



FMCW-A



FMCW-B

Operational Parameters	Specification	
Type	FMCW-A	FMCW-B
Centre Frequency	76.5GHz	76.5GHz
Bandwidth	500MHz	1000MHz
Noise Figure	<10dB	<15dB
Output Power	>13dBm	<12dBm
RX Conversion Gain	31dB	11dB
Size	120x80x27mm	68x33x19mm
Mass	<520g	<90g
Power Consumption	<5.7W	<2W

> How To Order

Contact factory

> Radiometer

Capabilities

Historically Farran has always been actively involved in radiometric solutions primarily for ground based meteorology and radio propagation studies below 100GHz. Most recently focus has been on the development of solutions using robust, high performance GaAs MMIC LNA technologies to meet the demand for smaller, lighter and higher frequency radiometers. Such radiometers have already been designed from 30GHz up to 300GHz to meet the requirements of certain applications such as a custom space qualified radiometer for earth remote sensing, imaging radiometer for security screening and marine environmental monitoring as well as other applications like atmospheric research, sounding, meteorology and radio propagation studies. Designs can be modular or integrated using a variety of techniques depending upon required performance using state-of-the-art MMIC's, sub-harmonic mixers and high sensitivity detectors. Solutions where possible employ a direct amplification and detection technique offering excellent sensitivity performance for a Total Power Radiometer type and high performance sub-harmonic mixers for heterodyne systems at higher frequencies. Any number of channels can be incorporated into a solution along with different frequency bands as well as dual polarisation capability.

The result of this work has been to produce excellent custom solutions for our customers offering state-of-the-art performance in terms of precision, accuracy and stability and for space applications, low mass and power consumption.

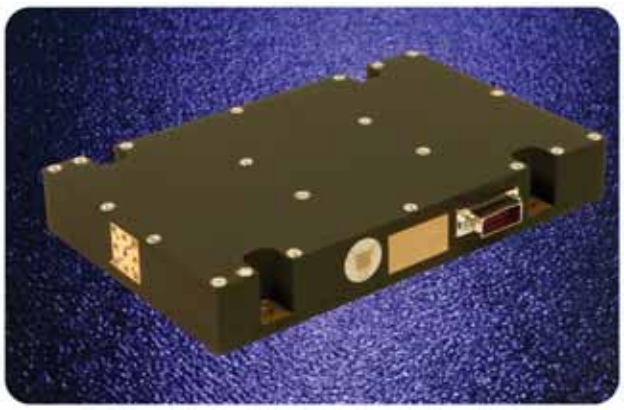
Future applications will be based around the evolution of higher frequency MMIC LNA's and Schottky diodes, to achieve direct detection solutions beyond 200GHz, and for higher THz frequencies, sub-harmonic mixers for heterodyne systems.

> Radiometer

>> 89GHz Radiometer

Description

Custom space qualified 89GHz Radiometer for weather forecasting and real time monitoring of meteorological disasters offering state-of-the-art performance.



89 GHz Radiometer (Flight Model)

Technology

Based on GaAs MMIC LNA's with thermally compensated gain and external gain control. High performance modular waveguide components including custom orthomode transducer and septum bandpass filter.

Specification

Passive, Direct Detection, Total Power Radiometer

Centre Frequencies	: 89GHz
Polarisation	: Horizontal and Vertical
Pre-Detection Bandwidth	: 3GHz
Noise Figure	: 6.5dB
Integration time	: 2.5ms
Input Range	: 3K – 350K
Radiometric Sensitivity	: <0.6K
Gain Stabilisation	: <2K over 2 hours
Linearity	: >0.999
Physical Size	: 205 x 130 x 30mm
Mass	: <1.2kg
Power Consumption	: <2W

This specification is a subset of the complete specification and you must consult the factory with your actual requirements.

> Radiometer

>> 300GHz Radiometer

Description

The 300 GHz radiometer test module consists of x16 multiplier chain, subharmonic mixer and horn antenna integrated on a common baseplate.

300 GHz Radiometer

Technology

Frequency range of subharmonic mixer is 296 – 304 GHz, with an LO frequency of 150GHz provided by x16 multiplier chain. Input LO frequency range of the radiometer and LO signal level is 9.25-9.5 GHz and 10 dBm, respectively.

Specification

LO Frequency Range	:	9.25-9.5 GHz
LO Power	:	+10 dBm nominal
RF Frequency Range	:	296 – 304 GHz
Maximum LO input power	:	<13 dBm
Conversion Loss	:	5-7 dB typical
LO/IF Port	:	SMA Female
IF DC Block bandwidth	:	10 MHz – 18 GHz
Supply Voltage	:	12 V
Current	:	800 mA typical

> Imaging Front-End

>> W-Band Imaging Front-End

Description

W-Band integrated direct-detect array module intended for security and other applications using high performance MMIC based sensors.

Picture of Equipment (Production Model)

Technology

High performance GaAs MMIC LNA's and detectors in an integrated packaged design suitable for imaging array front-ends.

Specification

Frequency: 75 - 110GHz
Gain: 50dB typical
Noise Figure: 5dB typical
Sensitivity: up to 1200mV Balanced Output

Physical Size: 125 x 28 x 13mm
Mass: 85g
Power Consumption: 0.25W

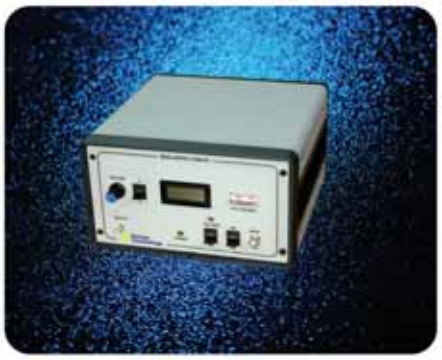
Complimentary Products

Farran Technology
Millimeter Wave Components & Subsystems.

Gunn Oscillator Bias Supply Model FDB-F8

Features

- Low Noise and Hum
- Compatible with Farran Technology Gunn Oscillators
- Digital Metering of Voltage and Current
- Phase Locking Capability
- Internal Modulation Facility



Applications

- Bias Supply for Gunn Oscillators
- Phase Locking of Gunn Oscillators
- Modulation of Gunn Oscillator

Description

The Farran Technology FDB-F8 Gunn Oscillator Bias Supply has been developed as a special purpose low noise Bias Supply for Gunn Oscillators. This requirement is essential to achieve the best spectral performance from the output of the Gunn Oscillator
This supply is therefore particularly suited for the requirement of phase locking the Gunn Oscillator using a Microwave Source Locking counter.
In addition, an internal modulation facility is available which provides 100% AM modulation of the Bias Supply output at a frequency of 1 KHz. Bias output connector is SMA and the instrument is housed in a specially designed heat sinking case.

Mixer and Detector Bias Supply Model FDB-F4

Features

- Fully Protected Battery Operated Bias Supply
- Compatible with Farran Technology Mixers and Detectors
- Buffering Output Connector for Remote Monitoring of Bias Parameters
- Panel Meter for Bias Voltage and Current Indication
- Current Limited in Two Separate Ranges
- Rechargeable Battery Included
- Minimum Stand-by Power Consumption
- Dual Polarity

Applications

Allows Fully Protected Operation of mm and Submm Low Noise Mixers and Detectors

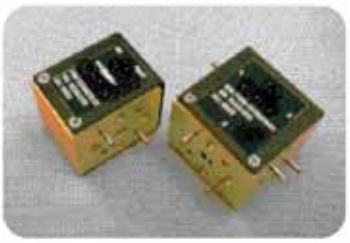
Description

The Farran Technology FDB-F4 Precision DC Bias Supply has been developed for use with high quality mixers and detectors. At mm and submm wavelengths these devices contain an ultra-low capacitance Schottky diode which must be biased in order to achieve maximum sensitivity. It is thus imperative that the bias supply be carefully designed if damage to, or failure of, the Schottky diode is to be avoided.
The FDB-F4 consists of a specially designed voltage regulated DC supply and includes two output current ranges, 1mA and 10mA, limited to full scale value. This protects the user from device burnout in case of sudden self-bias or improper bias. The supply is battery operated from a built-in rechargeable battery and is designed for minimum standby power consumption. The supply can be removed from its enclosure and rack mounted. The FDB-F4 also has a fully buffered output connector on the rear panel, enabling remote / external precision monitoring of voltage and current bias simultaneously.

Narrow Band Ferrite Junction Isolators and Circulators

Features

- High quality and volume production
- Compact size, light weight
- High performance
- Wide operation temperature range
- Common communication and radar frequency bands



Model ISO / CIRC Series

Applications

- Cavity oscillators
- Amplifiers
- Transceiver subsystems

Description

ISO and CIRC series narrow band junction isolators and circulators cover common communication and radar frequency bands from 8.2 to 110 GHz in 11 waveguide bands. The isolator is an ideal device where the port isolation is required, while the circulator is commonly used as a duplexer for transceiver subsystems where the transmitter and receiver ports share a single antenna port. The ISO and CIRC series isolators and circulators offer very compact size that can be easily inserted into the sub-assembly with minimum size increase.

> Narrow Band Ferrite Junction Isolators and Circulators

> ISO / CIRC Series Specifications

Model Number	Freq. (GHz)	Bandwidth (GHz,Min)	Insertion Loss (dB, Max)	Isolation (dB,Min)	VSWR (Typ)	Power (W,Min)
ISO/CIRC-90NB	8.2 to 12.4	1.0	0.3	23.0	1.3 :1	5.0
ISO/CIRC-75NB	10.0 to 15.0	1.2	0.3	23.0	1.3 :1	4.0
ISO/CIRC-62NB	12.4 to 18.0	1.5	0.3	23.0	1.3 :1	3.0
ISO/CIRC-42NB	18.0 to 26.5	2.0	0.3	22.0	1.3 :1	2.0
ISO/CIRC-34NB	22.0 to 33.0	2.0	0.4	18.0	1.3 :1	1.0
ISO/CIRC-28NB	26.5 to 40	3.0	0.4	18.0	1.3 :1	1.0
ISO/CIRC-22NB	33.0 to 50.0	3.0	0.5	18.0	1.3 :1	1.0
ISO/CIRC-19NB	40.0 to 60.0	3.0	0.5	18.0	1.3 :1	1.0
ISO/CIRC-15NB	50.0 to 75.0	2.0	0.6	18.0	1.3 :1	1.0
ISO/CIRC-12NB	60.0 to 90.0	2.0	0.7	18.0	1.3 :1	1.0
ISO/CIRC-10NB	75.0 to 110	2.0	0.8	18.0	1.3 :1	1.0

> Specify Model Number :

ISO/CIRC-WG CF BW IS –XX		
"I" or "C" for Isolator or Circulator	BW : Bandwidth in 1/10 GHz	IS : Isolation in dB
Wg : Size	CF : Center Frequency in GHz	XX : Factory Reserve

Example :
To order a center frequency 24.0 GHz isolator with 2 GHz bandwidth, 20 dB minimum isolation and WR-42 waveguide interface, specify ISO/CIRC-42242020-XX.

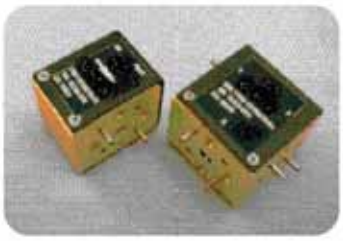
Please contact our sales representatives with your specific requirements.

Specifications subject to change without notice.

Full Band Junction Circulators and Isolators

Features

- Full waveguide band operation
- Low insertion loss
- High Isolation
- Compact size



Model ISO / CIRC Series

Applications

- Test setup
- Instrumentation
- Subsystems
- Transceivers

Description

ISO-FB series full band waveguide junction isolators and CIR-FB series full band waveguide junction circulators are available from 8.2 to 40 GHz frequency range in 5 waveguide bands. The isolators and circulators feature low insertion loss and high isolation for full waveguide bands operation. With H-plane junction configuration, the full band junction isolators offer a lower insertion loss compared to the Faraday rotation types, while circulators offer unique full band operation features. These devices are ideally suited for broad band communication systems, EW systems and test instrument applications.

> Full Band Ferrite Junction Circulators and Isolators

> Specifications

Frequency Band	X	WR-75	Ku	K	Ka
Model Number (Isolator)	ISO -90FB	ISO -75FB	ISO -62FB	ISO -42FB	ISO -28FB
Model Number (Circulator)	CIR-90FB	CIR-75FB	CIR-62FB	CIR-42FB	CIR-28FB
Freq. Range (GHz)	8.2 to 10.0	10.0 to 15.0	12.0 to 18.0	18 to 26.5	26.5 to 40.0
Waveguide size	WR-90	WR-75	WR-62	WR-42	WR-28
Insertion Loss (dB, Max)	0.3	0.3	0.4	0.5	0.7
Isolation (dB,Min)	20	20	20	19	18
VSWR (Typ)	1.25 :1	1.25 :1	1.25 :1	1.25 :1	1.25 :1
Flange Compatability	UG-39/U	WR-75	UG419/U	UG595/U	UG599/U
Power Handing (W,Min)	5	5	3	1	1
Outline Drawings	Consult Factory				

Full Band Faraday Isolators

Features

- Full waveguide band operation
- Faraday rotation type
- 18 to 110 GHz frequency range

Model ISFB Series

Applications

- Test setup
- Instrumentation
- Subsystems
- Transceivers

Description

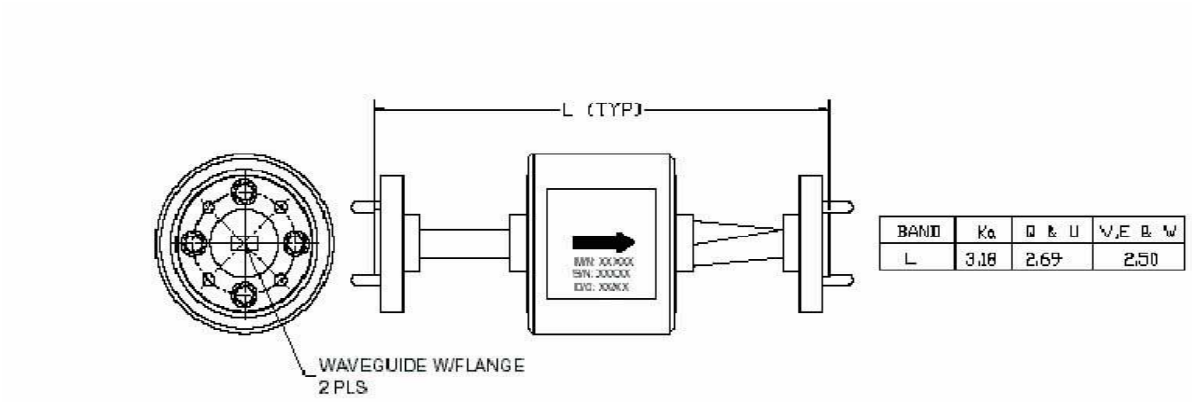
ISFB series full band Faraday waveguide are available from 18 to 110 GHz frequency range in 7 waveguide bands. The isolators feature moderate insertion loss and high isolation up to 30 dB for full waveguide bands operation. These devices are ideally suited for broad band communication systems or test instrument applications.

> Full Band Faraday Isolators

> Specifications

Frequency Band	K	Ka	Q	U	V	E	W
Model Number	ISFB-42	ISFB-28	ISFB-22	ISFB-19	ISFB-15	ISFB-12	ISFB-10
Freq. Range (GHz)	18-26.5	26.5-40	33-50	40-60	50-75	60-90	75-110
Waveguide size	WR-42	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10
Insertion Loss (dB, Max)	1.0	1.2	1.5	1.6	1.8	2.0	2.3
Isolation (dB,TYP)	30	30	30	30	30	30	30
VSWR (Typ)	1.4 :1	1.4 :1	1.4 :1	1.4 :1	1.4 :1	1.4 :1	1.4 :1
Flange Compatability	UG595/U	UG599-U	UG583/U	UG583/ U Mod	UG385/U	UG387/U	UG387/ U Mod

> Outline Drawing



* The outline is subject to change without notice. Please confirm with factory if the outline is a critical issue to your design.

Waveguide Noise Sources

Features

- Excess Noise Ratio (ENR) 15 dB typical
- High Stability
- Low Output ripple
- No High voltage Supply required
- Compact Solid state source
- High reliability , rugged

Waveguide Noise Source

Applications

- Calibration
- Noise figure measurement
- Instruments and test equipment
- Space and Hi-Rel system

Description

The new solid-state noise source delivers a uniform level of noise power density within the whole waveguide frequency range. Sources are available in eight waveguide bands covering 26.4 - 170 GHz. A Silicon IMPATT diode is employed as a fundamental building block of the source. The high stability of the device allows it to be used for test and instrumentation applications in place of gas-tube noise sources. Low DC power requirements eliminate the need for complex high voltage supplies. There are two operation modes: CW mode and pulsed AM mode with modulation frequency up to 1 KHz.

> Waveguide Noise Sources

Specifications

Model	WG-NS-28	WG-NS-22	WG-NS-19	WG-NS-15	WG-NS-12	WG-NS-10	WG-NS-08	WG-NS-06
Frequency Range (GHz)	26.5 -40	33-50	40-60	50-75	60-90	75-110	90-140	110-170
Connector Waveguide	WR-28	WR-22	WR-19	WR-15	WR-12	WR-10	WR-08	WR-06
Flange Compatability	UG-381/U or UG-599 /U	UG-383/U	UG-383/U-M	UG-385/U	UG-387/U	UG-387/U-M	UG-387/U-M	UG-387/U-M
ENR, dB nom.	15	14	13	13	13	12	12	12
Typ Flatness dB	+/- 1	+/- 1.5	+/- 1.5	+/- 1.5	+/- 1.5	+/- 1.5	+/- 1.5	+/- 2
Stability dB/ deg C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Stability (typ)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Biasing Voltage V	+18	+18	+18	+18	+18	+18	+18	+18

Notes:

1. Maximum operating temperature is +60 °C
2. Diode operating current is 50mA
3. A limiting value of modulation frequency is 1KHz (external triggering)
4. Triggering signal amplitude is TTL level
5. Bias voltage is +18V. It is possible to supply the noise source with +28 Vdc biasing for compatibility with commonly used noise meters.
6. ENR can be increased for narrower bandwidth. Please contact FTL.
7. Power supply for input power 220VAC/50Hz, 110VAC/60Hz or 100VAC/50Hz is available upon request

> Standard Waveguide and Flange-Size

Frequency GHz	EIA Waveguide	TE_{10} Mode Cuttoff GHz	Flange [1] Compatability	Flange Drawing	Optional [1,2] Flange	Flange Drawing
18 – 26.5	WR - 42	14.08	UG – 595/U	1		
26.5 – 40	WR - 28	21.10	UG – 599/U	1	UG – 381 / U	2
33 - 50	WR - 22	26.35	UG – 383/U	2	UG – 599 / U	
40 - 60	WR - 19	31.41	UG – 383/U - M	2		
50 - 75	WR - 15	39.90	UG – 385/U	2		
60 - 90	WR - 12	48.40	UG – 387/U	2		
75 - 110	WR - 10	59.05	UG – 387/U - M	2		
90 - 140	WR - 8	73.84	UG – 387/U - M	2		
110 - 170	WR - 6	90.85	UG – 387/U - M	2		
140 - 220	WR - 5	115.75	UG – 387/U - M	2		
170 - 260	WR - 4	137.52	UG – 387/U - M	2		
220 - 325	WR - 3	173.28	UG – 387/U - M	2		
325 - 400	WR - 2	211.0	UG – 387/U - M	2	Not EIA Flange	

1. Farran Technology flanges are fabricated in accordance with MIL-F-3922B.
2. Optional flanges other than specified above can be supplied on request.

> Ordering and General Information

> How to order

Instructions on how to order FTL components are included with most product data sheets in the "How to order" section. For standard, modified or custom components our staff are ready to assist with your application and offer service technical advice, price and delivery information. Our aim is to offer a prompt response to your enquiries. Final verification of model numbers, pricing and delivery will be made by FTL sales staff in the light of your particular requirements.

> Where to order

Address all purchase orders and other communications to:

FARRAN TECHNOLOGY LTD
AIRPORT EAST BUSINESS PARK
FARMERS CROSS,
CORK, IRELAND
Telephone: +353-21-4849170
Fax: +353-21-4849192
E-mail: sales@farran.com
Website: www.farran.com

> Sales Representatives

FTL has world-wide representatives to provide customer support wherever needed. Please feel free to contact your local representative whenever necessary. FTL will be pleased to advise of the appropriate contact in your location.

> Custom Components and Subsystems

FTL is extensively equipped for design and manufacture of custom components and systems. Please contact us with your requirements and our engineering staff will be pleased to discuss possible solutions.

> Warranty

All standard catalog items are warranted for a period of one year from the date of delivery against defects in material and manufacture. This warranty shall not apply to any products which have been subject to improper use, unauthorized repair, alteration or operation outside the relevant maximum ratings. FTL reserves the right of determination as to the cause and existence of any defect.

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