Design aspects and technologies to improve energy and space efficiency of SATCOM broadcast systems

Mitch Haft, Director of Sales

Overview

Part 1: Introduction to satellite communications

Part 2: Conventional redundant converter systems

Part 3: Third rack redundant converter systems

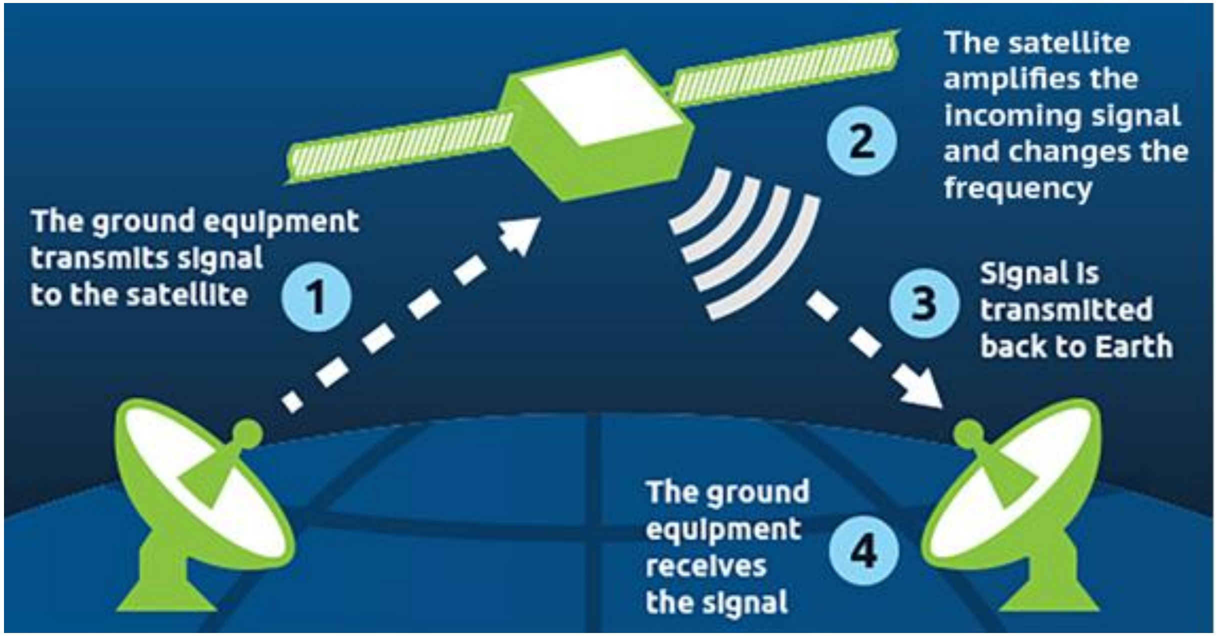
Part 4: Other SATCOM products for third rack configuration

Part 5: L-3 Narda-MITEQ SATCOM solutions

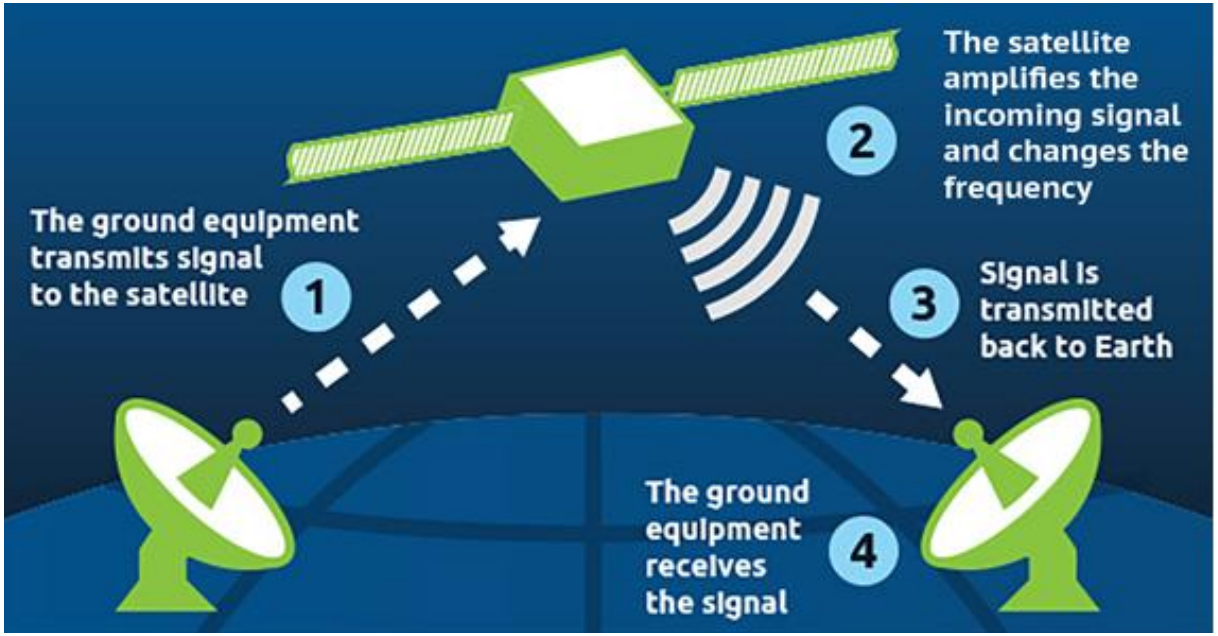
Introduction to satellite communications

Satellites are used as relay stations when traditional methods are not available (too far distance, etc.)

Earth stations transmit the signal up to the satellite and the satellite amplifies and modifies the signal to be transmitter down to the earth station



One Earth station sends a transmission to the satellite. This is called the Uplink
The satellite transponder converts the signal and sends it down to the second earth station. This is called the Downlink



Typical frequencies for satellite transmission (Uplink)
C-Band: 5.725-6.725 GHz
Ku-Band: 13.75-14.8 GHz
Ka-Band: 27.5-28.5 GHz

Typical frequencies for satellite reception (Downlink)
C-Band: 3.4-4.2 GHz
Ku-Band: 10.7-12.75 GHz
Ka-Band: 18.2-19.2 GHz

Synthesizer Converters

- WHAT IS A SYNTHESIZED CONVERTER?
  - Tuneable over the RF band
  - Narrow IF bandwidth (40, 80 MHz wide)
- WHERE ARE THEY USED?
  - Broadcast from single carrier users/lower data rate
  - Smaller antennas with lower broadcast power
  - Telemetry and control installations
  - Beacon input signals
- ADVANTAGES OF SYNTHESIZED CONVERTERS!
  - Flexible for various installations
  - Can be used with user specific modulation
  - Narrow band for lower data rate/less expensive transponder rental

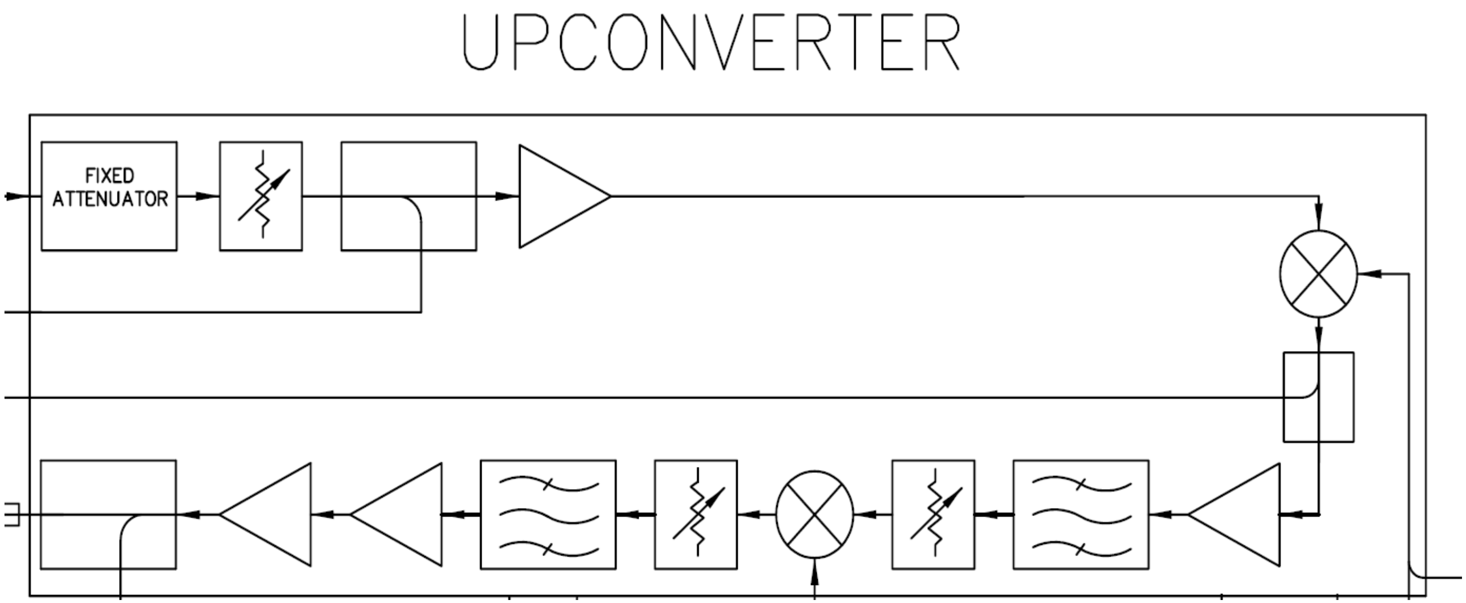
BLOCK CONVERTERS

- WHAT IS A BLOCK CONVERTER?
  - Fixed Tuned
  - Wide bandwidth (500 MHz to 2500 MHz)

- WHERE ARE BLOCK CONVERTERS USED?
  - IF Frequency is L-Band
  - C-Band, Ku-Band, X-Band, DBS-Band, etc.
  - Ka-Band, Q-Band, TDRSS with wide RF band

- ADVANTAGES OF BLOCK CONVERTERS!
  - Lower cost for full RF bandwidth
  - Small install for full RF bandwidth
  - Wide bandwidth for higher data rates

Let's talk more about the RF satellite frequency conversion
Typical upconverter block diagram (synthesized)



IF signal is feed into the upconverter

Gain control is used to adjust the signal strength

Signal is amplified and feed into first mixer stage

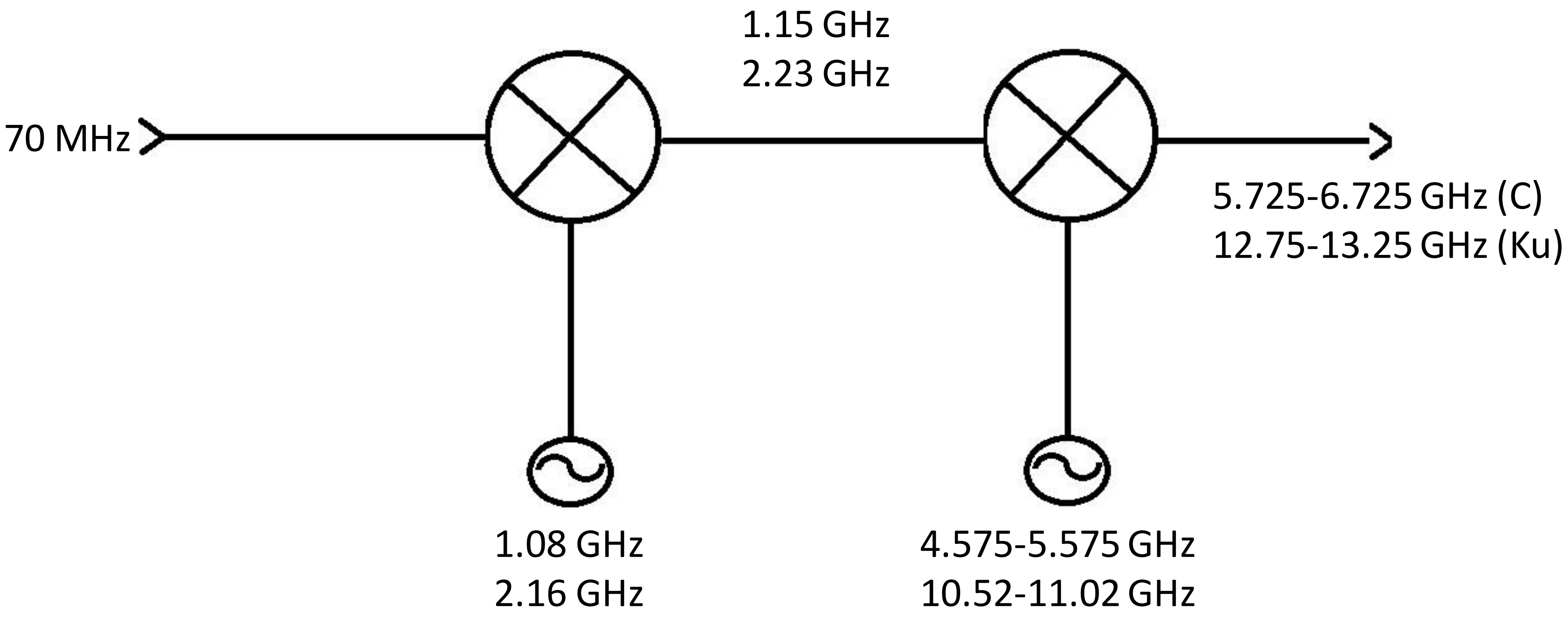
First mixer takes IF + Lo signal (fixed frequency oscillator) and outputs a 2nd IF signal (intermediate step)

2nd IF signal is amplified, filtered, gain controlled and feed into the second mixer stage

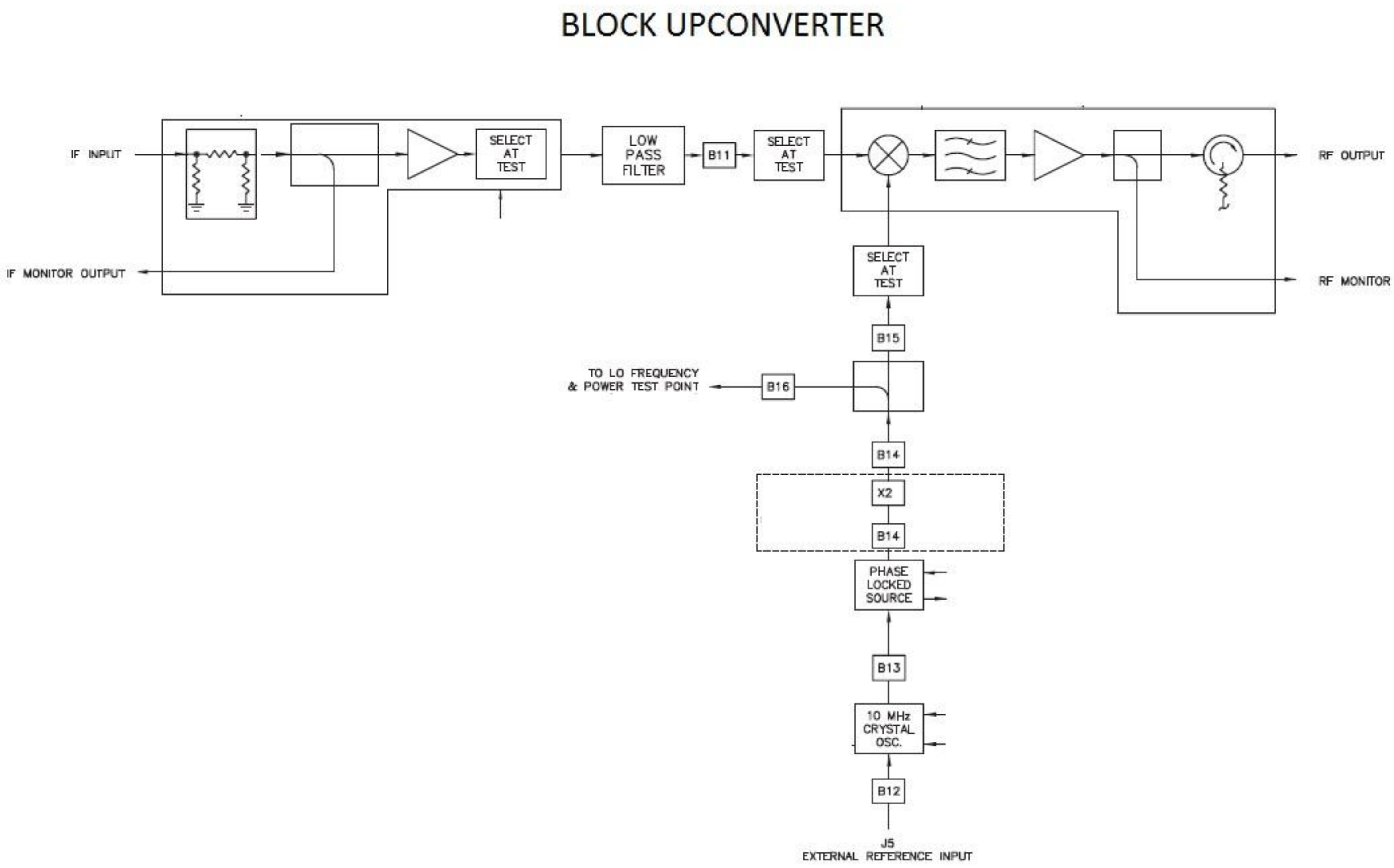
Second mixer takes 2nd IF (intermediate) + Lo (synthesized) to output RF (desired)

Desired RF output is amplified, filtered and gain controlled to send to the next SATCOM equipment (typically TWTA)

Upconverter scheme (dual conversion)



Typical upconverter block diagram (block)



Part 1

IF signal is feed into the upconverter

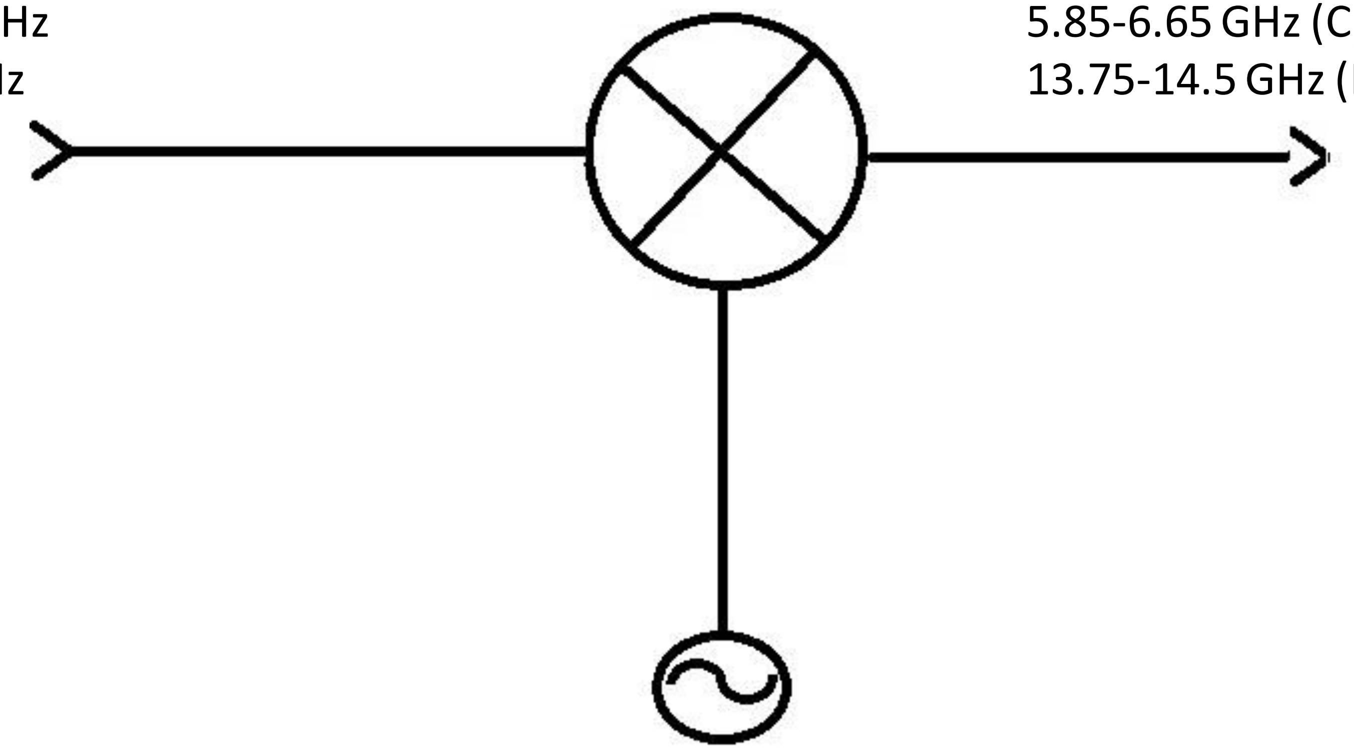
Gain control is used to adjust the signal strength

Signal is amplified, filtered and feed into the mixer stage

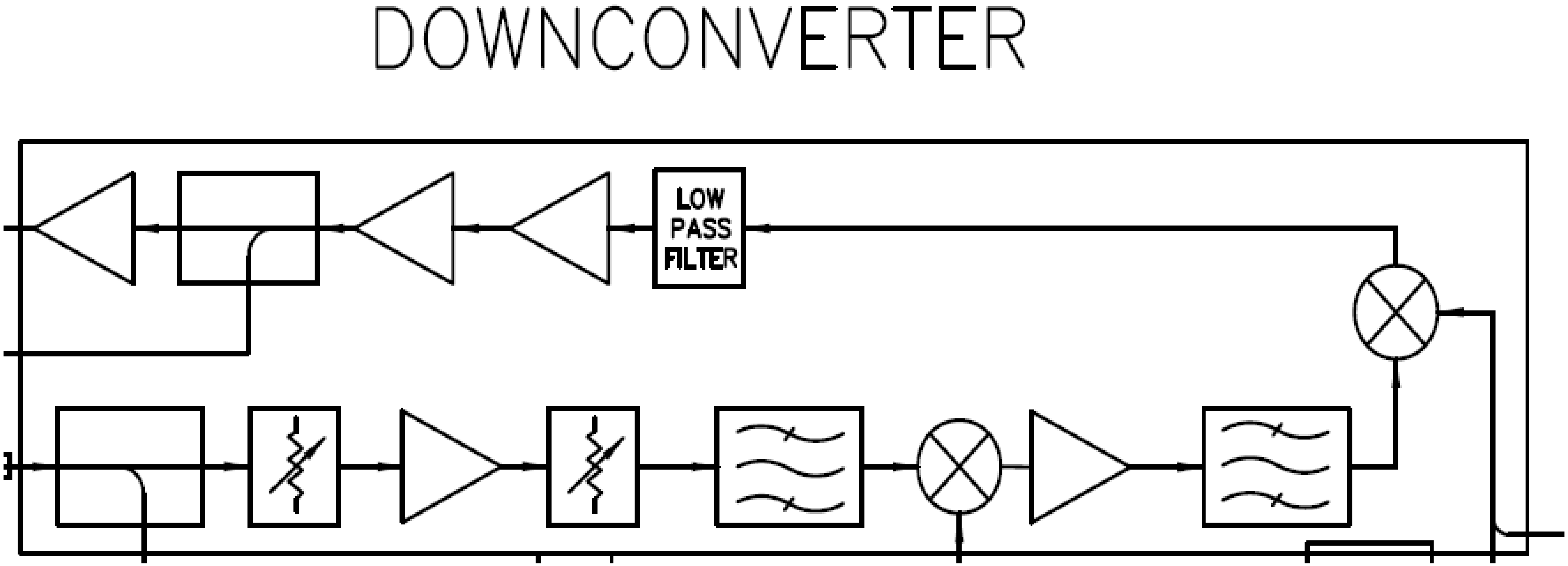
Mixer takes IF + Lo signal (fixed frequency oscillator) and outputs the RF (desired)

Desired RF output is filtered and amplified to sent to the next SATCOM equipment (typically TWTA)

Upconverter scheme (block converter)



Typical downconverter block diagram (synthesized)



Part 1

RF signal from the satellite is feed into the downconverter

Signal is amplified, filtered and feed into first mixer stage

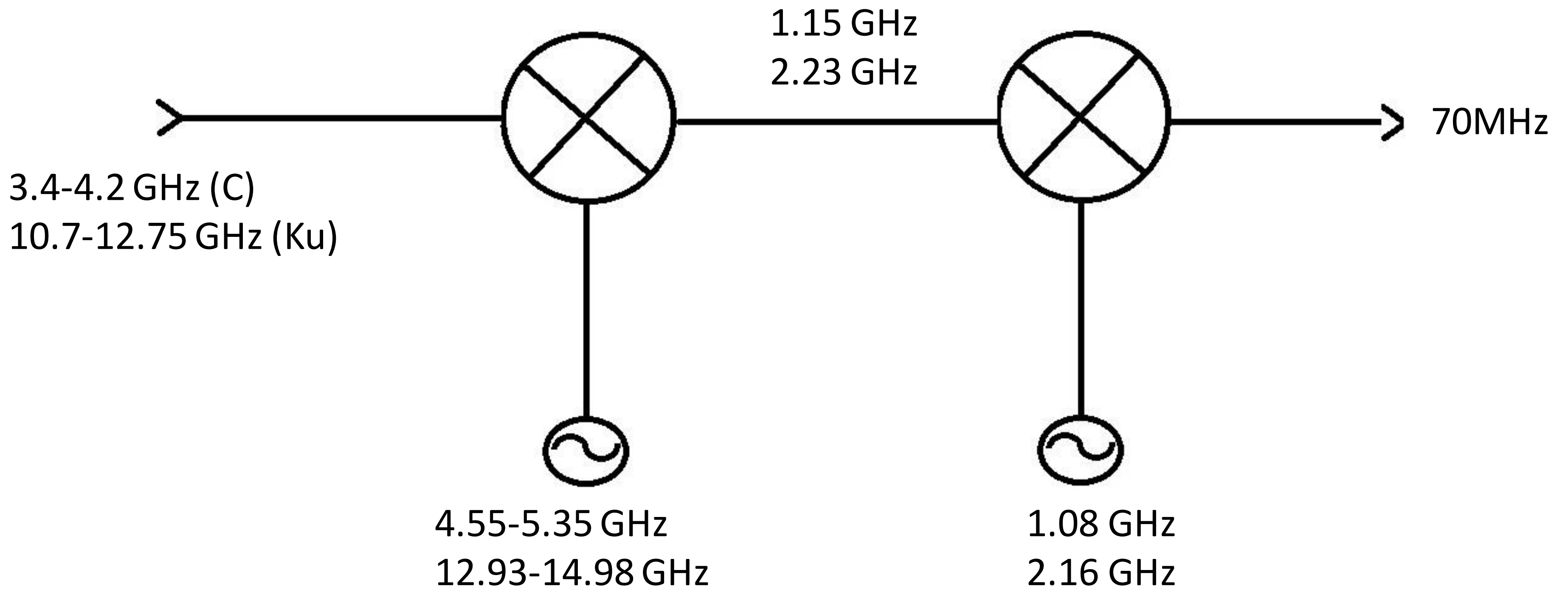
First mixer takes RF - Lo signal (synthesized) and outputs a 2^{nd} IF signal (intermediate)

2^{nd} IF signal is amplified, filtered, gain controlled and feed into the second mixer stage

Second mixer takes 2^{nd} IF (intermediate) - Lo (fixed tuned) to output IF (desired)

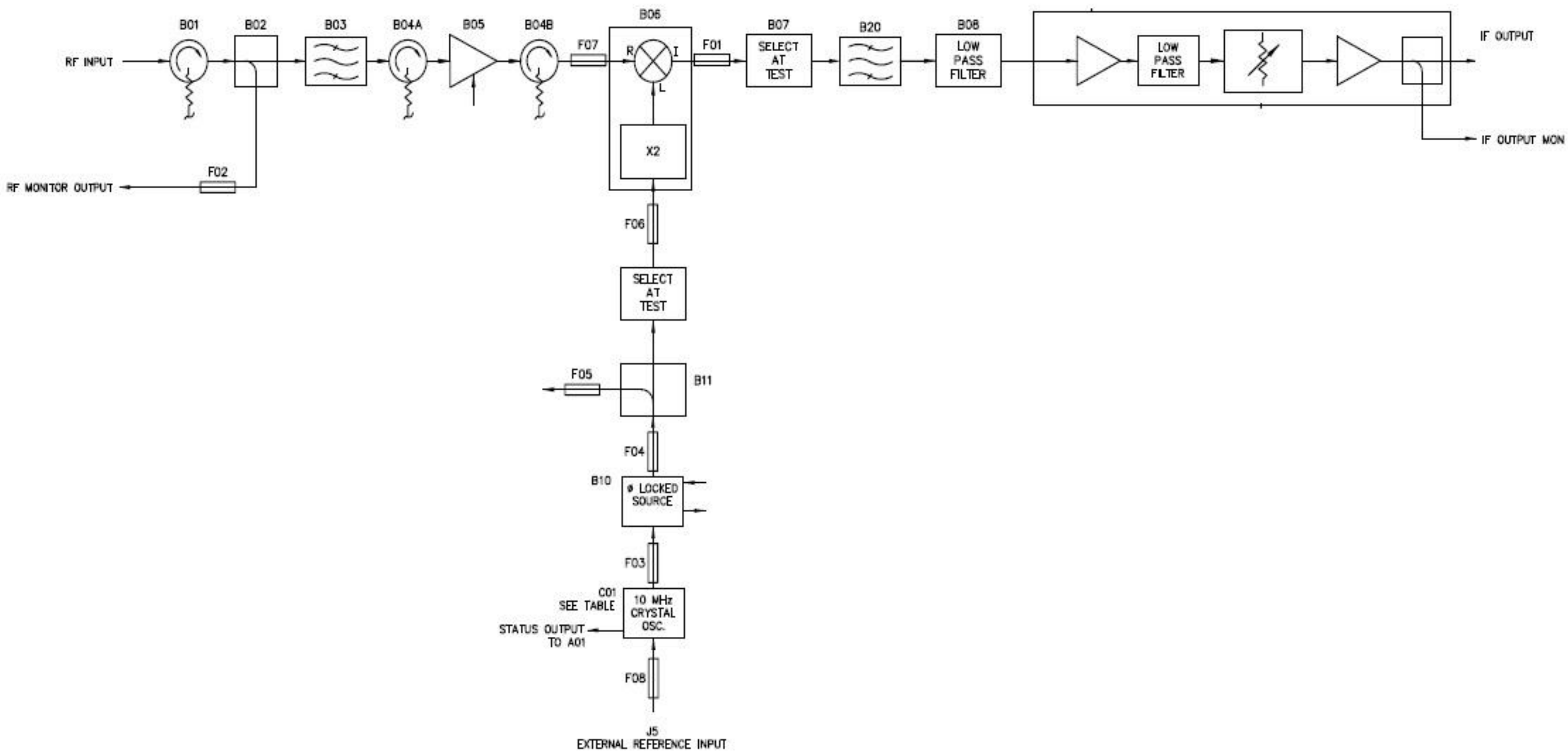
Desired IF output is amplified, filtered and gain controlled to send to the next SATCOM equipment (typically modem)

Downconverter scheme (dual conversion)



Typical downconverter block diagram (block)

BLOCK DOWNCONVERTER



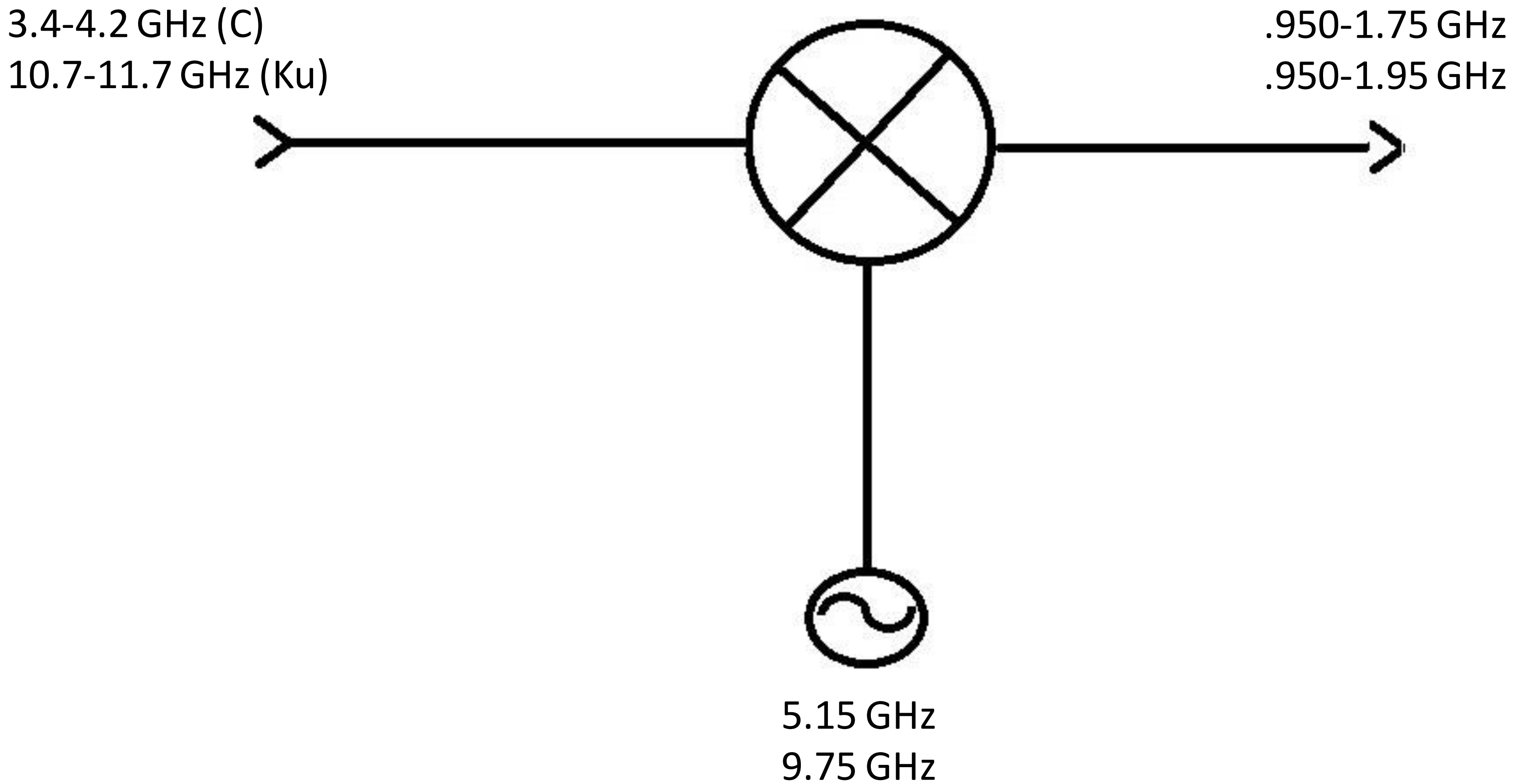
RF signal from antenna is feed into the downconverter

Signal is amplified, filtered and feed into the mixer stage

Mixer takes RF - Lo signal (fixed frequency oscillator) and outputs the IF (desired)

Desired IF output is filtered and amplified to sent to the next SATCOM equipment (typically modem)

Downconverter scheme (block converter)



Conventional redundant converter systems

Typical Earth stations employ redundant setups to ensure no loss of signal (down time)

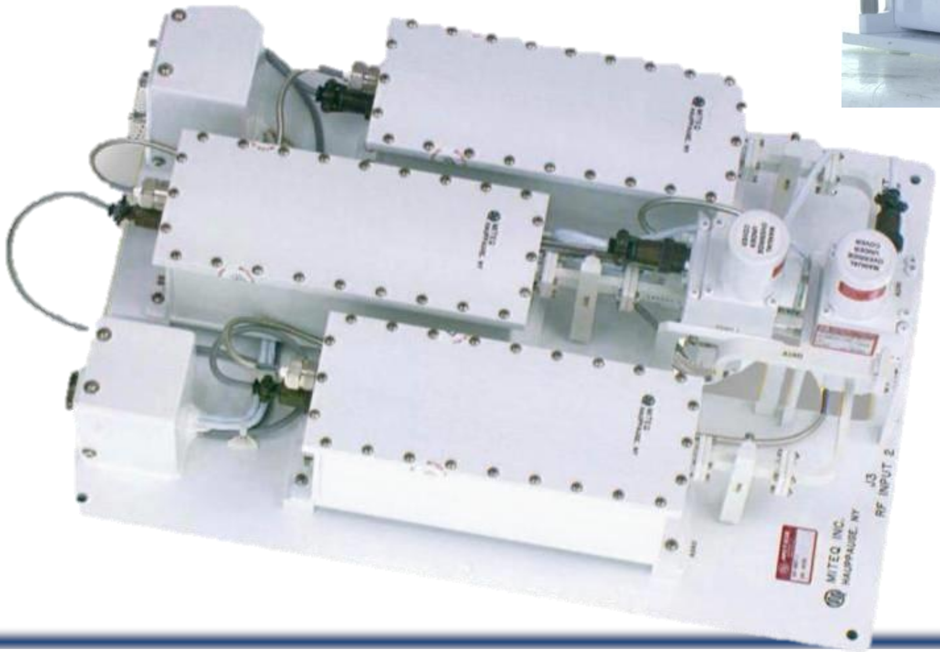
Earth stations utilize an on-air unit and a backup unit incase the on-air unit fails

Redundancy can be employed in outdoor or indoor units

In some instances, a total earth station could be used as redundancy

Outdoor redundant converters (1:1 redundant with two converters and switching unit)

1:2 redundant plate



Indoor redundant converters (1:1 two converters and switching unit)

1:1 redundancy consists of:

One on-line unit

One standby unit

One switching unit

1:2 redundancy consists of:

Two on-line units

One standby unit

One switching unit

Shown 1:7 redundant system

Third rack redundant converter systems

With the patented third rack block converter solution you can realize:

Compact rack space

Greater operating efficiency due to less components

Higher MTBF due to less components

Indoor redundant converters (1:1 using third rack units)

U.S. Patent #7,510,090

1:1 and 1:2 Block Converter Configuration

Features:

- L- to RF block upconverters: C- through Ka-bands
- RF to L-band downconverters: C- through Ka-bands

One Third Rack Series - Features

Shown with optional LCD front panel

- Compact unit
- Low phase noise
- Low power consumption
- Low intermodulation distortion
- Gain control
- Automatic 5/10 MHz and Int/ext reference selection
- L- and RF-bands signal monitors ports
- High frequency stability

- Integrated fiber
- Mute function on alarm or external mute input command
- LO frequency and power monitor
- Status
- RS422/485 and 10/100Base-T Ethernet

Some key performance differences:

	Advantech ARUD-LCXT UP	Advantech ARDD-CXLT DN	Peak IBU6725 UP	Peak IBU340 DN	N-MITEQ UPB1-6.25TR	N-MITEQ DNB1-3.8TR
Noise figure	N/S	20	N/S	N/S	15	15
Output IP3	10	N/S	18	18	25	30
Output Power (P1dB)	0	5	8	8	13	18
Amplitude Response	± 1.5 dB/ 575 MHz	± 2.0 dB/ 800 MHz	± 1 dB/ 575 MHz	±1.5 dB/ 800 MHz	±1 dB/ RF band	±1 dB/ RF band

Other SATCOM products for third rack configuration

Test Loop Translators Features:

- **C-, X-, Ku-, K- and Ka-bands available**
  - **RFTx band to RFRx**
  - **RFTx band to L-band**
- **30 dB level control**
- **Local oscillator monitor port**
- **Output signal monitor port**

3 YEAR WARRANTY

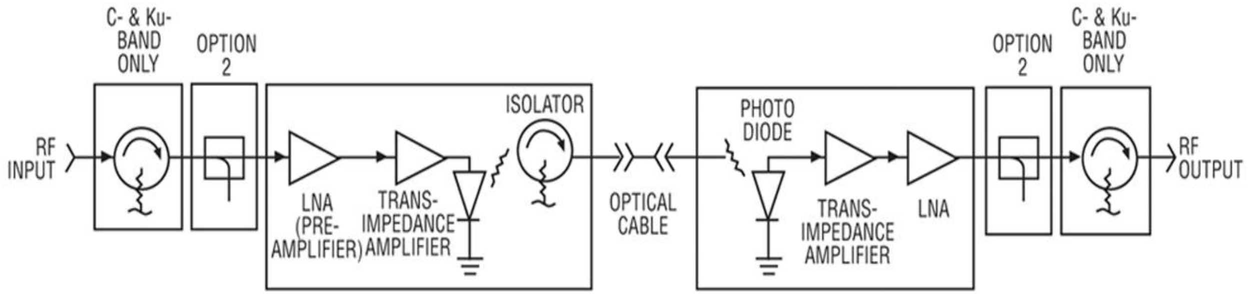
Amplifiers and Equalizers Series Features:

- **RF hot swappable units**
- **Rack mountable**

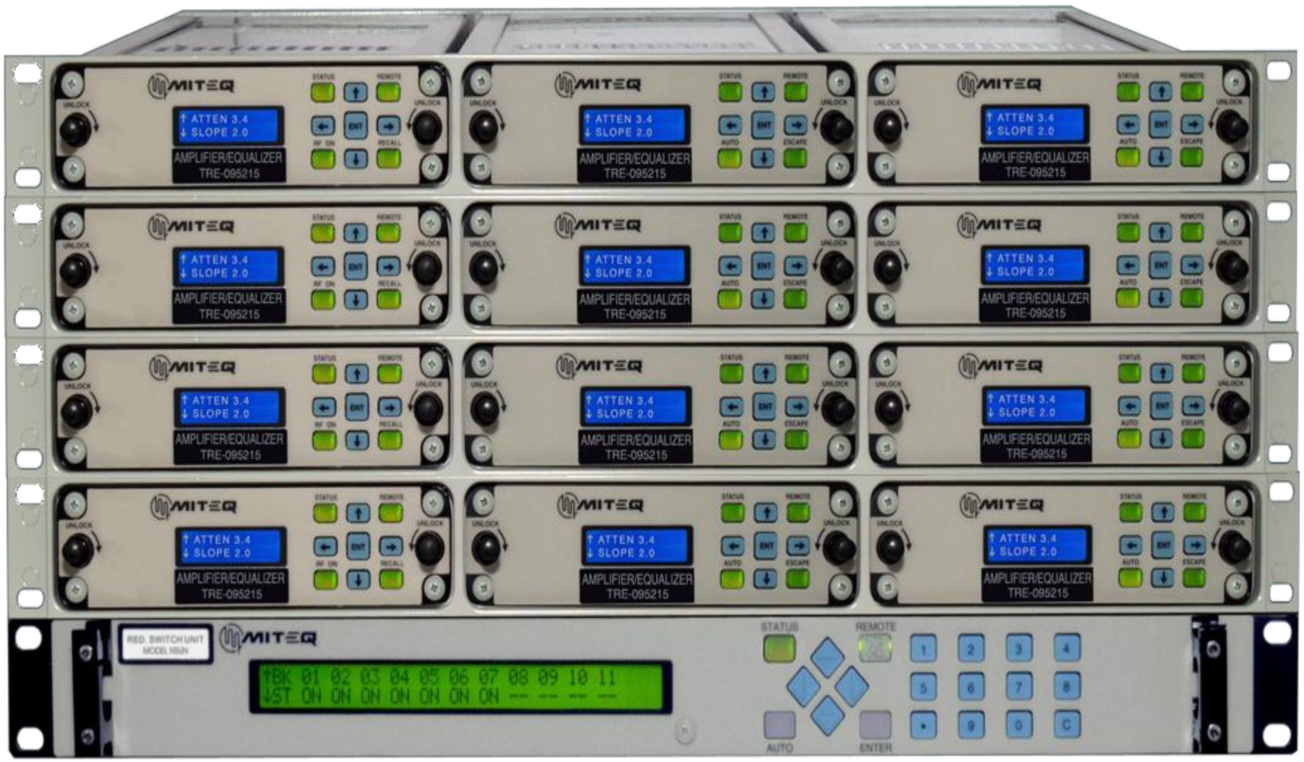
Fiber-Optic
Transmitters and Receivers

Features:

- Longer transmission paths than coaxial cable
- Easy installation, lightweight and flexible
- Fiber is unsusceptible to lightning strikes
- Provides EMI / RFI insulation
- Larger bandwidths
- High dynamic range
- Low noise figure



Up to 1:12 Redundant Configurations in 300% Less Rack Space!



1:11 Redundant Configuration shown

L-3 Narda-MITEQ SATCOM solutions

Part 5

- Block Converters
- Synthesized Converters
- Translators

- Amplifier Systems

- Group Delay and Amplitude Equalizers
- Uplink Power Control Units

- Receivers

- Redundancy Switchover Systems

- Special Products

Thank you for your attention