

ITSO - Basics of Satellite Communications

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Envision. Connect. Transform.

Up-Converter (U/C)

- L-Band to C-Band
 - 950 - 1450 MHz input
 - 5.925 – 6.425 GHz output
 - Non inverting (4.900 GHz LO)
 - Inverting (7.375 GHz LO)
 - 500 MHz bandwidth
- L-Band to Ku-Band
 - 950 - 1450 MHz input
 - 14.00 – 14.50 GHz output
 - Non inverting (LO = 13.050 GHz)
 - Inverting (LO = 15.450 GHz)
 - 500 MHz bandwidth

Up-Converter (U/C)

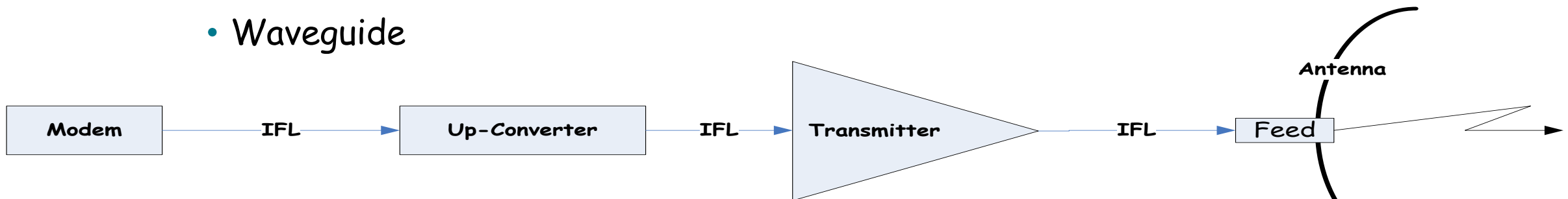
- 70 MHz to C-Band
 - 70 \pm 18 MHz input
 - 5.850 – 6.425 GHz output
 - Non inverting
 - 36 MHz bandwidth
- 140 MHz to C-Band
 - 140 \pm 36 MHz input
 - 5.850 – 6.425 GHz output
 - Non inverting
 - 72 MHz bandwidth

Up-Converter (U/C)

- 70 MHz to Ku-Band
 - 70 \pm 18 MHz input
 - 14.00 – 14.50 GHz output
 - Non inverting
 - 36 MHz bandwidth
- 140 MHz to Ku-Band
 - 140 \pm 36 MHz input
 - 14.00 – 14.50 GHz output
 - Non inverting
 - 72 MHz bandwidth

Uplink Block Diagram

- Modulator / Modem
- Up-Converter
- **Power Amplifier**
- Antenna
- Inter Facility Link (IFL)
 - Fiber Optics
 - Co-axial cable Combiners / Splitters
 - Waveguide



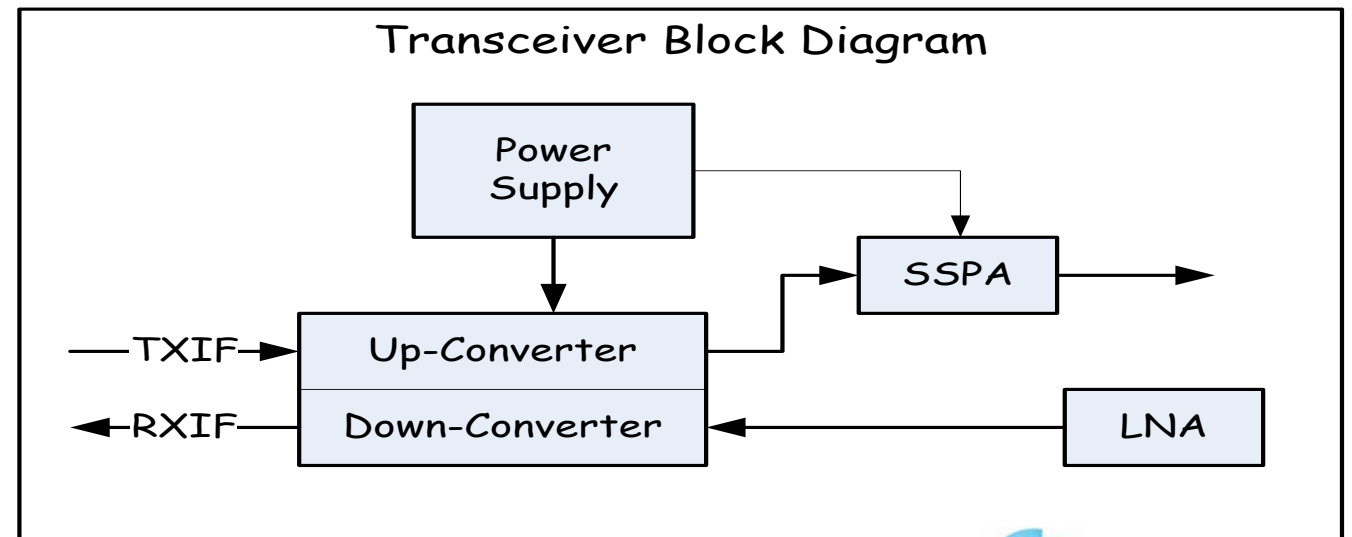
Simplified Uplink Block Diagram

Power Amplifiers

- High Power Amplifiers - HPA
 - Solid State Power Amplifiers - SSPA
 - Travelling Wave Tube – TWT
 - Klystron Power Amplifier KPA
- Including/excluding Up-conversion
- Transceivers

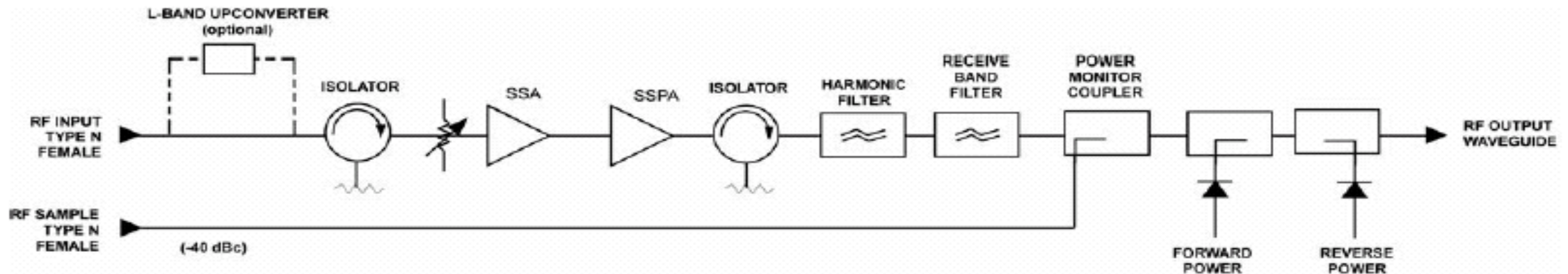
Transceiver

- Combination Power Supply, Up / down converter, HPA and LNA - PSU
- Mounted on / at the antenna
- 70 or 140 MHz or L-Band input
- RF Output C/Ku/Ka-Band output
- Single or dual synthesized converters
 - Uplink
 - Downlink



Solid State Power Amplifiers

- Typical output power 5 to 200 Watts
- 500 MHz bandwidth
- Non Linear
- L-Band Up-Converter optional
 - Requires external 10 MHz reference
 - Requires Diplexer
- Typically ≈ 3 dB OBO for multi carrier operation

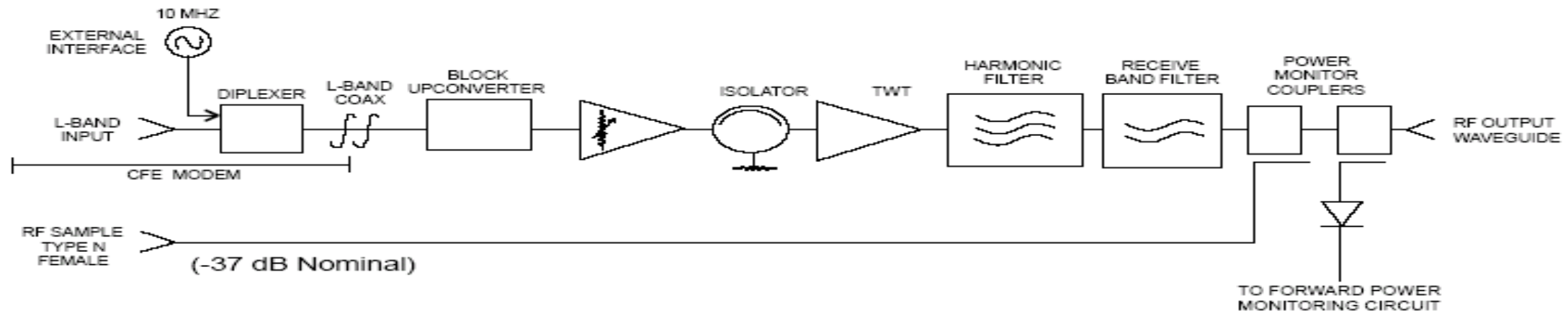


Solid State Power Amplifiers

- Lower Power 1- 200W
- Lower OBO for multicarrier operation
- Cost effective
- Low maintenance
- Power efficient
- Susceptible to power and lightning damage

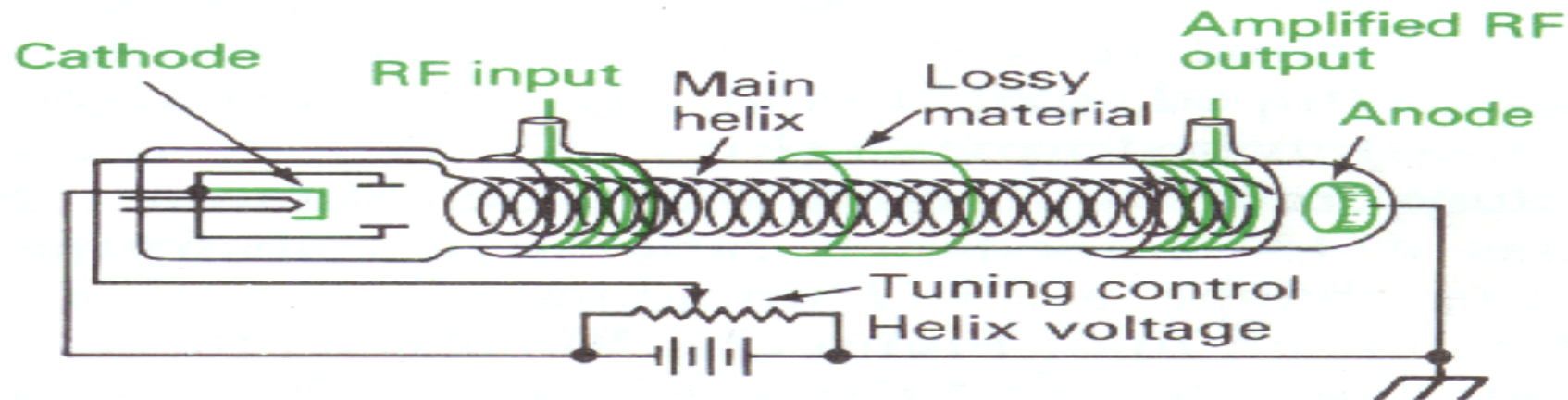
Travelling Tube Amplifier

- Typical output power 100 – 750 Watts
- 500MHz - 750 MHz bandwidth
- Non Linear
- Built in BUC optional
 - Requires 10 MHz external reference and Diplexer
- ≈ 7 dB OBO for multi carrier operation
- ≈ 4 dB OBO with linearizer for multi carrier operation



Transmitters (HPA)

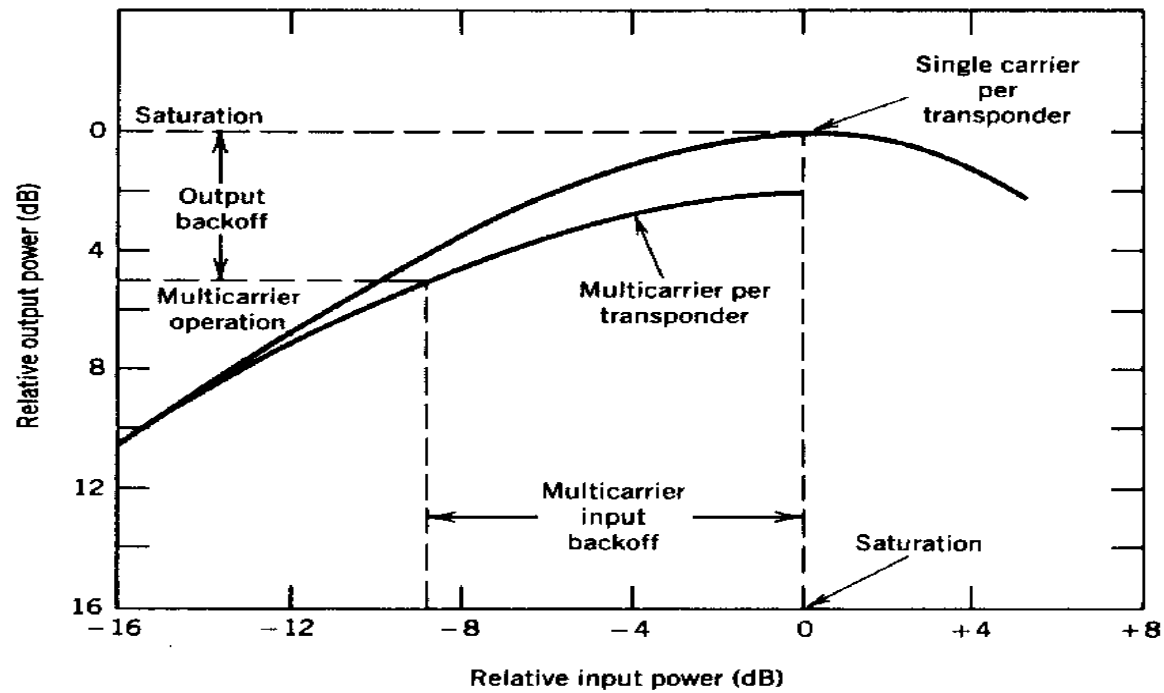
- HPA HIGH POWER AMPLIFIER
 - TRAVELING WAVE TUBE AMPLIFIER
 - WIDEBAND (FULL SPECTRUM) GREATER 500MHz
 - NON LINEAR
 - SMALL SIGNAL SUPPRESSION
 - AMPLITUDE TRANSFER CURVE



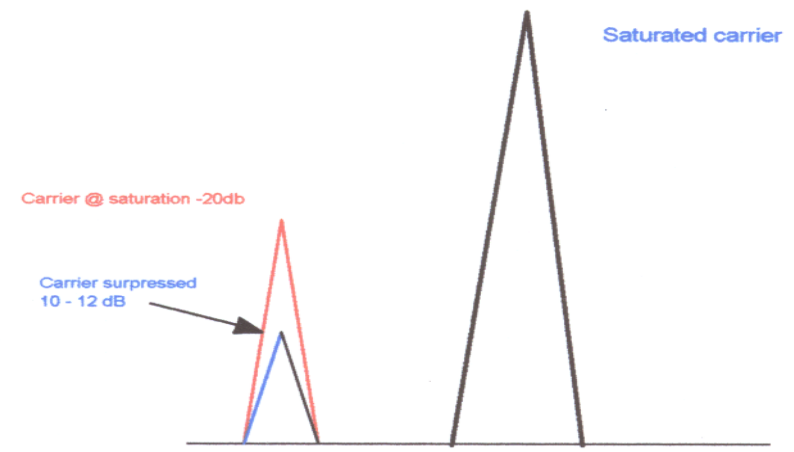
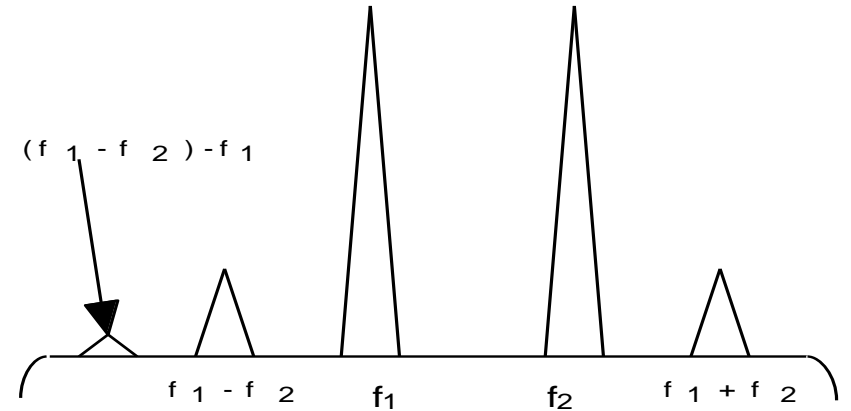
Traveling-wave tube, or TWT.

Transmitters (HPA)

- SMALL SIGNAL SUPPRESSION
- AMPLITUDE TRANSFER CURVE
- INTERMODULATION

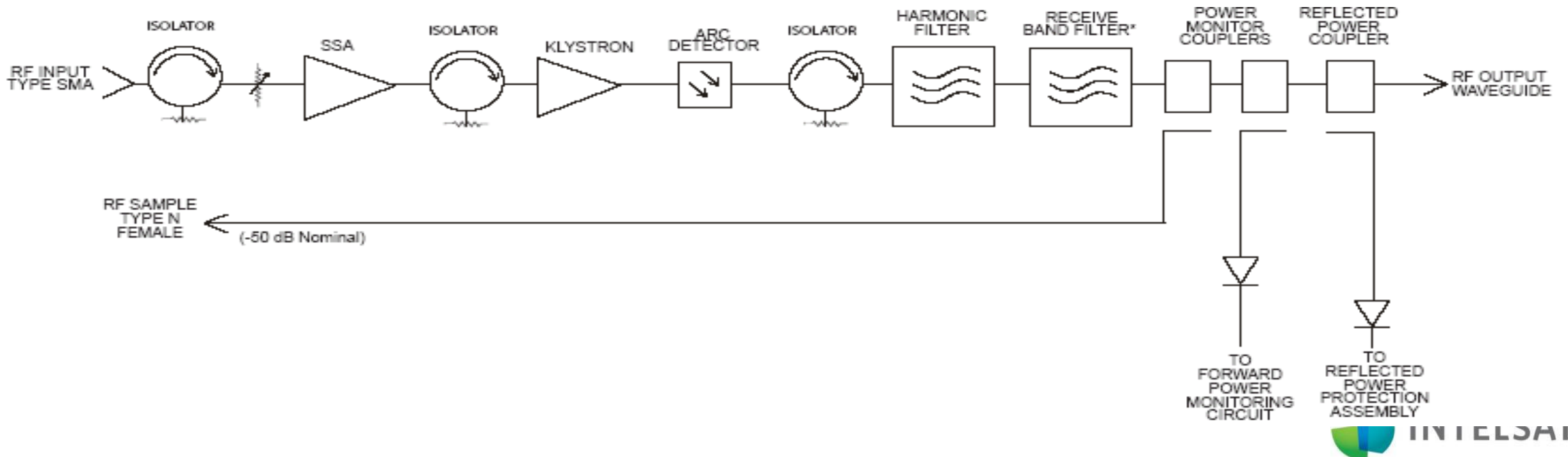


TWTA characteristics.



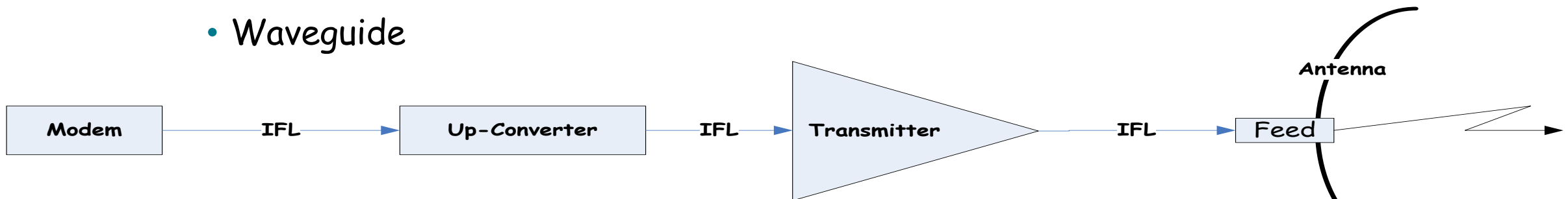
Klystron Power Amplifier

- Typical output power 1000 to 3000 Watts
- Non linear
- 40 or 80 MHz bandwidth
- OBO \approx 2 dB for dual carrier operation
 - \approx 7 dB for multi carrier operation



Uplink Block Diagram

- **Modulator / Modem**
- Up-Converter
- Power Amplifier
- Antenna
- **Inter Facility Link (IFL)**
 - Fiber Optics
 - Co-axial cable Combiners / Splitters
 - Waveguide



Simplified Uplink Block Diagram

Inter Facility Linking

- Co-axial cabling
 - Data and base band
 - IF
 - L-Band
 - C-Band
 - Ku-band

RF Co-axial Cabling

- Important factors
 - Higher Frequency higher losses
 - Losses indirectly proportional to cable diameter
 - Skin effect
 - To a point
 - Losses directly proportional to frequency
 - Reflections – impedance mismatch
 - Cable damage
 - Water
 - System impedance
 - Connector

Waveguide

- Used at C-Band and higher frequencies
- Lower loss than co-axial cable
- Types:
 - Rigid
 - Flexible, Flexible and twistable
 - Elyptical
- Not wideband – Frequency determines dimension

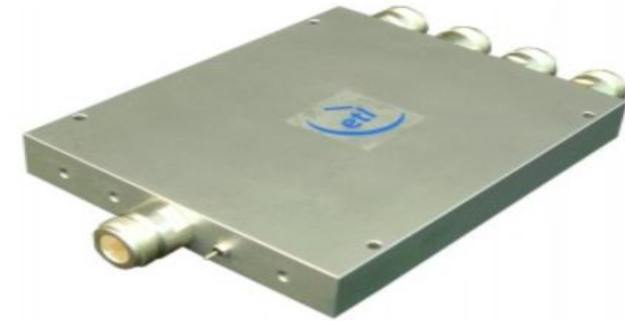
Combiners Small Signal

- Types

- IF
- L-band
- C-Band/Ku-band

- Considerations

- Losses
- Impedance matching
- Terminating unused ports



Combiner - Wideband

- 3dB Coupler
 - Co-axial
 - Waveguide
 - High power
 - Wideband
 - 3dB loss Dummy load required



Combiner - Filter

- Co-axial
- Waveguide
- Variances
 - One port wideband
 - Other port narrowband
 - Low insertion losses



Technology Trends



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Technologies

Addressing your Bottom Line through the use of the latest technologies

- DVB-S2 Extensions
- Adaptive Coding and Modulation
- Carrier in Carrier Technology
- Lower Roll off factors
- New Technology in Satellites
- Antennas Advancements to reach new markets

DVB-S2 & Extensions

A new standard enables true convergence

- Excellent spectral efficiency:
 - Up to 40% bandwidth saving compared to DVB-S
 - Up to 2dB better than Turbo Codes
 - HDTV enabler
- Unlike DVB-S, DVB-S2 is optimised for MPEG *and* IP
- Allows for DTH and DTT distribution in single carrier



Thank you

Questions ?



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