



# **General Principles for Earth Station Operators**

---

# General Principles for Earth Station Operators

1.	The Satellite	3
2.	Satellite Frequency Bands	3
3.	The Geo-Stationary Arc – “Clarke Belt”	3
4.	Natural Satellite Related Outages	3
5.	The Satellite Link	4
5.1.	The Parabolic Satellite Antenna	4
5.2.	Earth Station Antenna Mounts	4
5.3.	Feedhorns	4
5.4.	Tracking systems	5
5.5.	Uplink Power Control	5
5.6.	Figure of Merit (G/T)	5
5.7.	Selecting the Uplink Site	5
5.8.	MODEMS	5
5.9.	Up & Down converters; BUC; BDC	6
5.10.	LNA/LNB	6
5.11.	HPA	6
6.	General Earth Station / VSAT Operations	6
6.1.	RF Safety	6
6.2.	Antenna Pointing / Alignment	6
6.3.	Configuring the Transmit chain	6
6.4.	Configuring the Receive chain	6
6.5.	Universal Access Procedures	7
6.6.	Trouble Shooting the Transmit Chain	7
6.7.	Trouble Shooting the Receive Chain	7
6.8.	Routine Earth Station Maintenance	7
6.9.	Recommended Test Equipment	7
7.	Link Budget Calculations	8
7.1.	Earth Station Parameters	8
7.2.	Satellite Parameters	8
7.3.	System Noise	8
7.4.	System Interference	8
7.5.	Atmospheric Effects	8

---

# General Principles for Earth Station Operators

## 1. The Satellite

- ◆ Geostationary Orbits
- ◆ Non-inclined Orbit
- ◆ Inclined orbit

## 2. Satellite Frequency Bands

- ◆ Ku-band
- ◆ C-band
  - Circular Polarisation*
  - Linear Polarisation*
- ◆ Ka-Band

## 3. The Geo-Stationary Arc – “Clarke Belt”

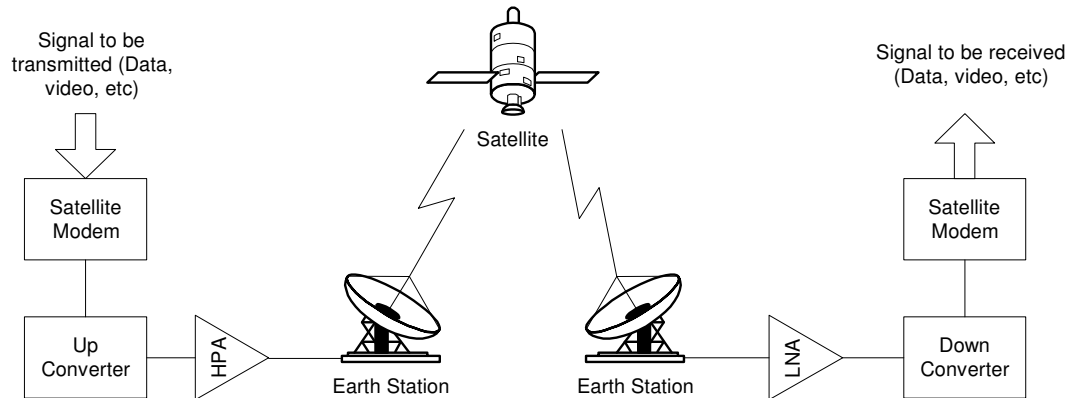
- ◆ Satellite co-ordination
  - ITU*
  - Inter-satellite co-ordination*
- ◆ Identifying your satellite

## 4. Natural Satellite Related Outages

- ◆ Solar Eclipse
  - Sun Outages*
  - Preventative actions*

---

## 5. The Satellite Link



### 5.1. The Parabolic Satellite Antenna

- ◆ Focal length, F/D ratio
- ◆ Prime-focus; Off-set; Cassegrain; Gregorian
- ◆ Antenna Gain and Efficiency
  - 0.5dB + 3dB Beamwidth*
- ◆ Antenna Radiation Patterns
  - Transmit sidelobe patterns*
  - Side-lobe masks (New Skies, ITU)*
- ◆ Polarisation Discrimination (*Linear polarisation*)
- ◆ Voltage Axial Ratio (VAR) (*Circular polarisation*)

### 5.2. Earth Station Antenna Mounts

- ◆ Elevation/Azimuth
- ◆ X/Y

### 5.3. Feedhorns

- ◆ Cross-polarised feed
- ◆ Co-polarised feed

---

#### **5.4. Tracking systems**

- ◆ Step; Programme; Manual

#### **5.5. Uplink Power Control**

- ◆ Set-up procedure
- ◆ Dangers of operating UPC

#### **5.6. Figure of Merit (G/T)**

- ◆ Definition and derivation

#### **5.7. Selecting the Uplink Site**

- ◆ Site survey
- ◆ Satellite view; Power availability; Cable length
- ◆ Checking for Terrestrial Interference
  - Assessing impact of Local Interference*
  - Terrestrial Microwave links*
  - SHF Wireless networks*

#### **5.8. MODEMS**

- ◆ Modulation techniques
  - PSK; QAM; ASK; FSK*
  - Error Correction*
  - Filtering Techniques*
  - Roll-off factor*
- ◆ Performance indicators
  - E<sub>b</sub>/N<sub>0</sub>; C/N; C/No; BER*
- ◆ MCPC; SCPC
- ◆ DVB

---

### **5.9. Up & Down converters; BUC; BDC**

- ◆ Function Description  
*Advantages / Disadvantages*

### **5.10. LNA/LNB**

- ◆ Function Description  
*Advantages / Disadvantages*

### **5.11. HPA**

- ◆ TWT; Klystron; SSPA  
*Basic Principles and characteristics*  
*Methods of tuning and adjusting frequency*  
*Advantages / Disadvantages*

## **6. General Earth Station / VSAT Operations**

### **6.1. RF Safety**

- ◆ Basic reminders of RF hazards and HV risks

### **6.2. Antenna Pointing / Alignment**

- ◆ Azimuth and Elevation
- ◆ Polarisation Angle (Linear Polarisation)

### **6.3. Configuring the Transmit chain**

- ◆ Inter-facility link; Modem; Up-converter; HPA  
*Balancing the link from start to finish*

### **6.4. Configuring the Receive chain**

- ◆ LNA/B; Down-converter; Modem; Inter-facility link  
*Local Oscillator conversions*

---

**6.5. Universal Access Procedures**

- ◆ Contacting the satellite operator
- ◆ Radiating a carrier under control of the satellite operator

**6.6. Trouble Shooting the Transmit Chain**

- ◆ Working through the various component blocks

**6.7. Trouble Shooting the Receive Chain**

- ◆ Working through the various component blocks

**6.8. Routine Earth Station Maintenance**

- ◆ Preventative maintenance
  - Cleaning Air filters*
  - Lubricating moving parts*
  - Recording power and signal levels at monitoring points*
  - General "Best Practice" activities*

**6.9. Recommended Test Equipment**

- ◆ Spectrum Analyser
- ◆ BER monitor
- ◆ Power meter + coupler
- ◆ Co-axial + wave-guide transitions/loads
- ◆ Various cables suitable for RF + IF
- ◆ Inclinator + Compass

---

## 7. Link Budget Calculations

### 7.1. *Earth Station Parameters*

- ◆ G/T
- ◆ HPA Size
- ◆ Antenna Gain
- ◆ Antenna Tracking

### 7.2. *Satellite Parameters*

- ◆ Satellite Antenna Patterns
- ◆ Satellite Saturated Flux Density (SFD)
- ◆ Satellite Effective Isotropic Radiated Power (EIRP)
- ◆ Satellite Orbital Inclination
- ◆ Satellite Transponder operating Modes
  - Automatic Level Control (ALC) Mode*
  - Fixed Gain Mode (FGM)*

### 7.3. *System Noise*

- ◆ Uplink Thermal Noise
- ◆ Transponder Intermodulation Noise
- ◆ Downlink Thermal Noise
- ◆ Overall Noise Performance

### 7.4. *System Interference*

- ◆ Adjacent Satellite Interference
- ◆ Adjacent Channel Interference
- ◆ Cross-Channel (cross-polarisation) Interference

### 7.5. *Atmospheric Effects*

- ◆ Rain Fade
- ◆ Depolarisation