ECA GROUP
make sure

Antenna Tracking Chain

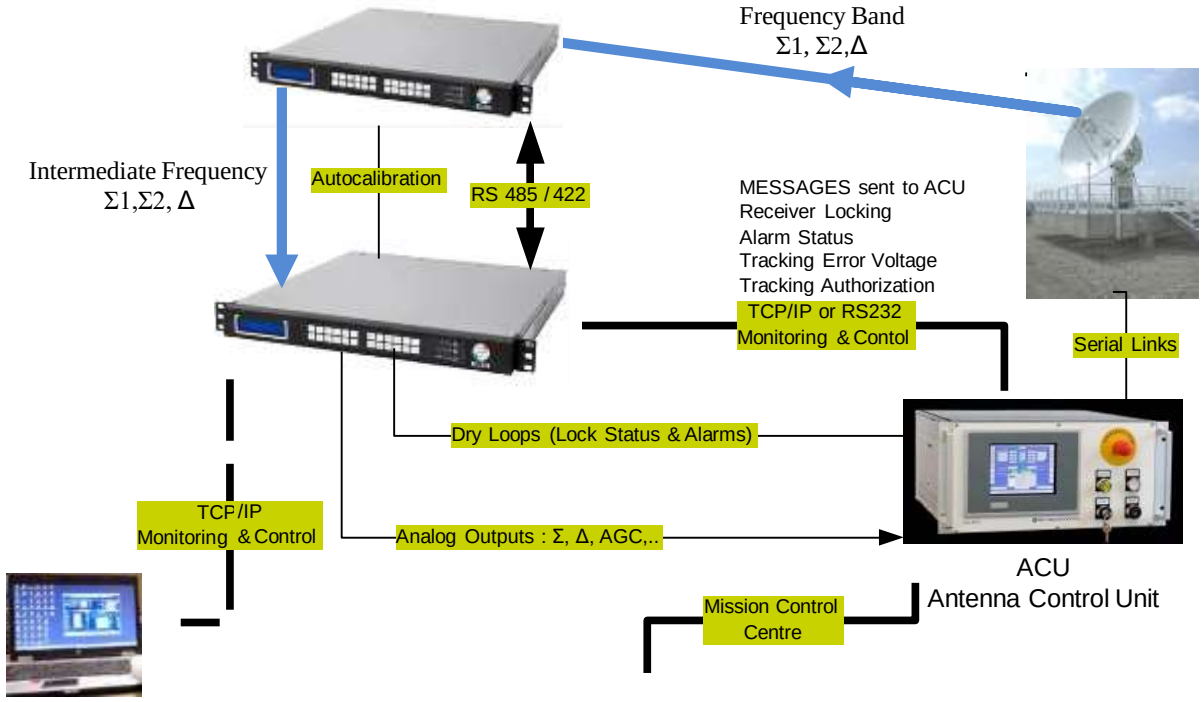
Table of Contents

Introduction

- ECA is a significant actor since more than 20 years in supply of Tracking Chains and products.
  - CTR70 : Monopulse or Monoscan Tracking Receiver
  - DTC : Range of indoor / outdoor down converters (L, S, C, X and Ku Band) specially designed for CTR70 tracking receivers.
  - STR Step Track Receiver or Beacon receiver.

Tracking System Overview

- ECA Group system is composed of a tracking receiver and a tracking converter fully managed through the tracking receiver (CTR70).

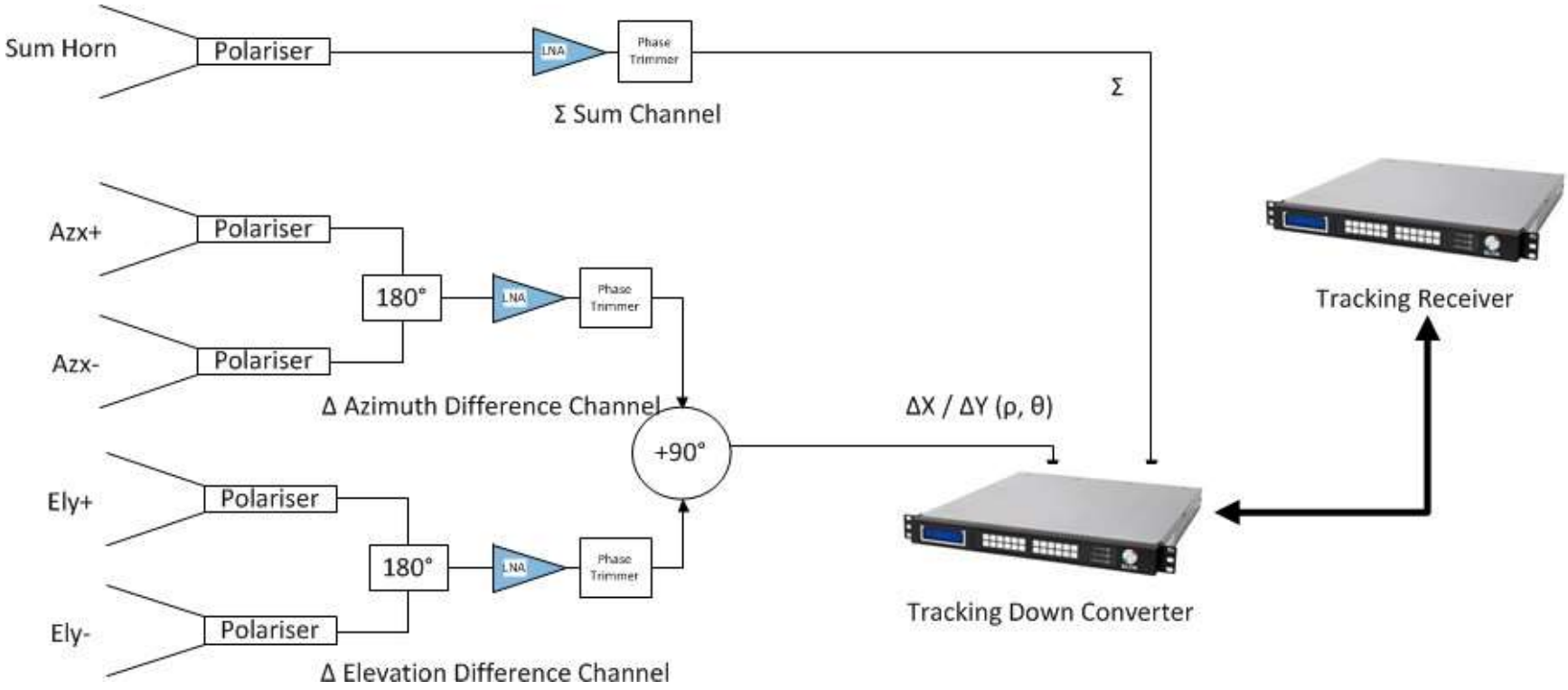


Tracking Receiver Overview

- ECA monopulse tracking receivers provide antenna control unit with high accuracy pointing instructions (analog and / or digital information).
- The CTR70 receiver has multipurpose modulation capabilities and can be set-up either in coherent mode or non coherent mode.
- Our different models (2, 3 channels) are suited to different kind of feeds:
  - Linear or circular polarization.
  - No multiplexing (no deterioration of the signal to noise ratio)
  - Error phase variations tolerant thanks to local or remote adjustment.
  - Capability for setting differential phase and amplitude between channels.
- “Auto-Calibration mode” : This function provides the tracking chain with a long term stability on the differential phase & amplitude between channels. This function is only available with ECA Group DTC.
- Autophasis Function which enables the alignment of the Mono-pulse Tracking system in terms of phase

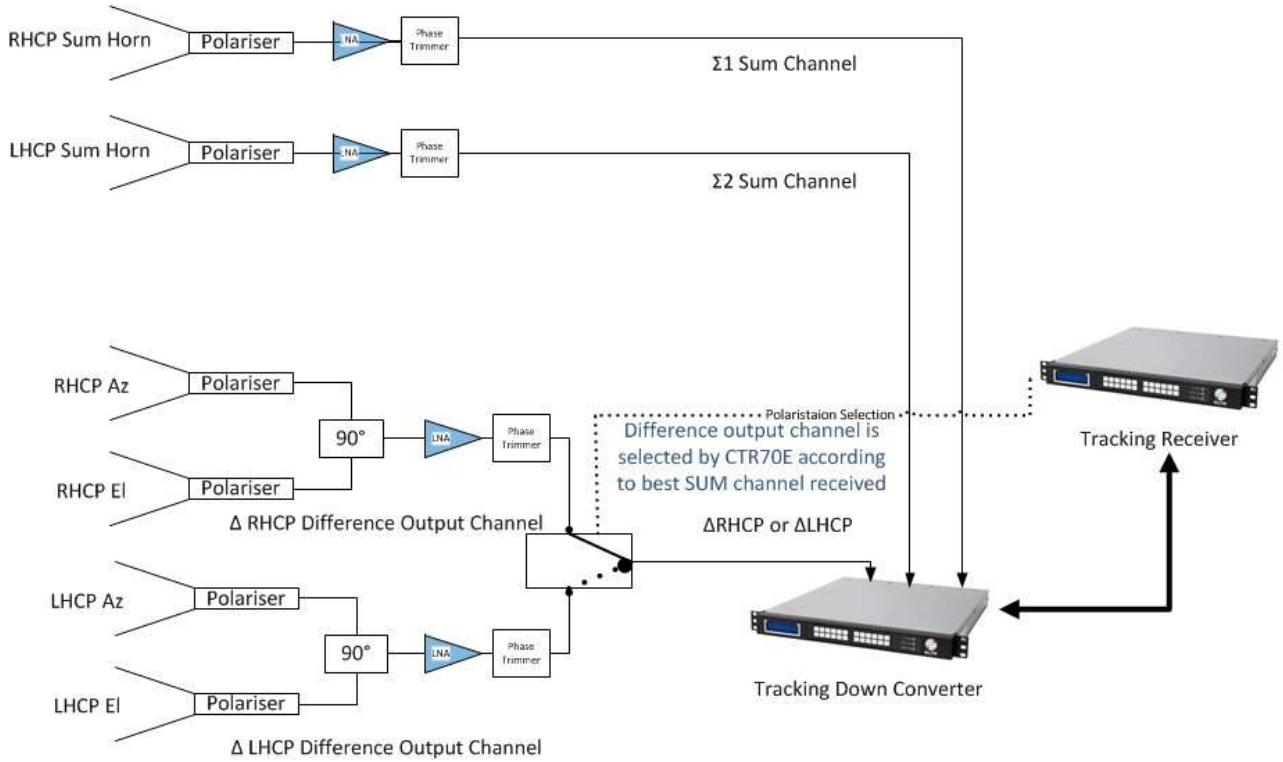
Tracking Receiver Overview

- CTR 70B 2 Channels Monopulse Tracking
  - Feed delivers 2 signals : ∑, Δ (ρ, θ)



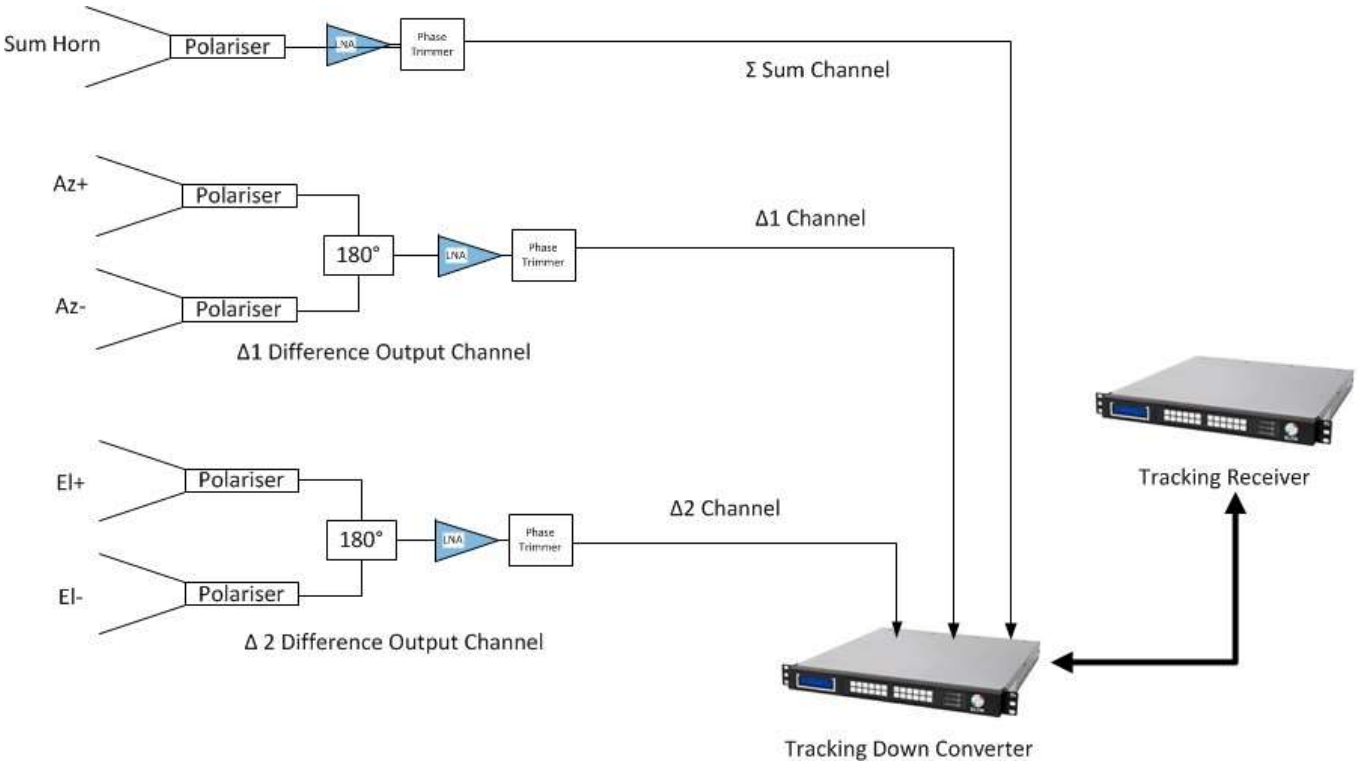
Tracking Receiver Overview

- CTR 70E: 3 Channels Monopulse Tracking
  - Feed delivers 3 signals : (∑1, ∑2, Δ) CTR70E enables tracking either in RHCP or LHCP polarization
    - **Auto-diversity function** : Based on AGC value, the best receiving SUM channel signal (either RHCP or LHCP difference channel) is manually or automatically selected to perform the tracking.



Tracking Receiver Overview

- CTR 70F: 3 Channels Monopulse Tracking
  - Feed delivers 3 signals : (∑, Δ 1, Δ2)



Tracking Receiver Main Features

- Common Tracking receivers features

Input

Nominal carrier frequency : 70 MHz
Input signal bandwidth : 5MHz max. (coherent mode)
Input impedance : 50 Ω
Connector : SMA Female
Input VSWR : < 1,5 dB
Isolation between ports : > 60 dB IF
and image rejection : > 50 dB
Noise figure : < 10 dB
Sum channel dynamic range: - 100 dBm to –10 dBm
Error channel level at error signal maximum : from 5 to 25 dB below sum channel
Input noise spectral density (max level) : - 100 dBm/Hz
Minimum signal/Noise density: 8 dB in the loop bandwidth (coherent)
Or 3 dB above threshold (non coherent)
Maximum input signal level : + 13 dBm without permanent damage
Input signal modulation : PM or FM/ MPSK/ Spread Spectrum

Coherent tracking mode

PLL loop bandwidth : 10, 30, 100, 300, 1000 and 3000 Hz
Damping factor : 0,7 ±0,2
Anti side band limits : Max PM index modulation 2 rad
Acquisition time (ASB OFF) on search range of + 150 kHz without noise:

Loop bandwidth	Time to lock:	
	1 kHz	: 0,1 sec
	300 Hz	: 0,6 sec
	30 Hz	: 4,3 sec
	10 Hz	: 375 sec

AGC time constant : 10 ms for monopulse / 30 ms monoscan

Non-coherent tracking mode

Selectable IF bandwidths : 50 kHz, 150 kHz, 500 kHz, 1.5 MHz, 5 MHz
Selectable IF threshold level : from -10 dBm to -100 dBm by 1 dB step

Search frequency range

Acquisition range (for both coherent and no coherent mode) is configurable from +/-1 kHz to +/-1.5MHz in 1 kHz step.
Center Sweep frequency : ±1500 kHz selectable 1 kHz step

Tracking Receiver Main Features

- Common Tracking receivers features

Output to servo control unit

Output bandwidth : According to integration time
Output level adjustable : up to ± 10 V with the gain and
± 5 V offset adjustment on X and Y
Output impedance : 1KΩ (Typical value)
Integration time : 1, 10, 100, 1000 ms
APA output : Available when there is no alarm on Tracking Chain and when receiver is locked
Auto calibration reference between the DTC unit and the receiver is carried out 5 sec. after lock and after every X minutes:
Differential phase stability : ± 5°
Amplitude stability : ± 1 dB versus time/dynamic range

Frequency reference

Input Frequency : 5 MHz or 10 MHz
Impedance : 50 Ω
Level : 0 dBm ±3 dB (13 dBm max.)
Connector : SMA Female
Output frequency : 10 MHz
Impedance : 50 Ω

Test IF output

Number of outputs : 3 (according to Model)
Frequency output : 70 MHz
Output signal bandwidth : 5 MHz
Output impedance : 50 Ω
Output VSWR : ≤1.5 dB
Output level : -30 dBm ±2 dB
(regulated output, AGC ON)
Connector : SMA Female

Remote Control

Link : RS232 and Ethernet

Environmental Conditions

Operating temperature : 10° C to + 45° C
Transport and storage temperature : -30° C to +70° C
Relative humidity : 95%

Tracking Down Converters for CTR70

- Tracking Down Converter features

Input

Input frequency	: S-Band 2.2 - 2.3 GHz
	: C-Band 3.4 - 4.2 GHz / 4.8 GHz
	: X-Band 7.25 - 7.75 GHz
	: X-Band 8.0 - 8.5 GHz
	: Ku-Band 10.0 - 12.75 GHz
	: Ka-Band : 17.7 – 21.2 GHz
	: Ka-Band : 25.5 – 27.0 GHz
Channels	: 3 (depends on model)
Impedance	: 50 Ω
VSWR	: ≤1.5
Connectors	: depends on model

Output

Output frequency	: 70MHz
Channels	: 3
Impedance	: 50Ω
VSWR	: ≤1.3
Connectors	: SMA Female
Differential Phase Gain	: Autocalibration Correction

Reference

Input frequency	: 5 or 10MHz (automatic detection)
Impedance	: 50Ω
VSWR	: ≤1.3
Connector	: BNC Female
Dynamic range	: 0 dBm +/-3 dB

Environmental Conditions

Operating température	: +10° C to +45° C (Indoor Model)
	: -30° C to +50° C (Outdoor Model)

Remote control

RS422 with dedicated CTR70 (DB9S)

Auto-Calibration

- **Auto-Calibration** : This function provides the tracking chain with a long term stability on the differential phase & amplitude between channels. That is to say: you preserve your pointing accuracy in long term.
- Built-in inside tracking down-converter or external, auto-calibration is automatically managed by the tracking receiver.
- Auto-Calibration provides customers with a real advantage in term of quality and performances of tracking.

Monitoring & Control

- DTC and CTR Monitoring & Control commands

DTC Commands

Input frequency	:yes
Channel Gain per channel	:yes
Local / Remote	:yes

DTC Monitoring

Channel Gain	: Returned current value is monitored
Local / Remote	: yes

Remote control

DTC is 100% controlled and monitored through RS422 by CTR70 (DB9Sconnector)

CTR70 Commands

Input frequency
Sweep range
Sweep Centre
Polarity on each axis per Channel
Gain correction on each axis per Channel
Open loop
Offset voltage on each axis
Polarity, Offset and Slope on Automatic Gain Control
Acquisition threshold
Anti-side band
Loop bandwidth
Level Offset
Manual phase per Channel
Phase step per channel
Tracking mode
Autophasing
Autocalibration and Autocal period
Error voltage integration time
Manual Gain
Tracking slope ratio
DTC attenuation per Channel
Autodiversity Threshold
Phasing external modulation: From O° to 359° with 1° step
Channel polarity 90°
Output error type

CTR70 Monitoring

All mentioned commands and equipment status (lock , Unlock,, Output voltage value, alarm,...) are monitored.

Remote control

CTR70 is 100% controlled and monitored through RS232 or TCP/IP by the Antenna Control Unit and / or by external Laptop.

How to perform a good tracking

- Reminders
  - CTR70 is able to track :
    - Beacon carrier signals (with a carrier in coherent mode)
    - Suppressed carrier signals (AM/FM/QPSK/…/Spread Spectrum in no coherent mode).
  - Minimum Signal / Noise density :
    - 8 dB in the loop bandwidth (coherent)
    - 3 dB above threshold (non coherent)
  - Predicted Doppler value @ 70MHz must be included within the limits of CTR70 Sweep Range (SWR).
    That is to say from ±1 kHz to ±1500 kHz with 1kHz steps.

How to perform a good tracking

- Coherent Mode:
  - 2BL Value, in coherent mode must be selected according to expected S/N ratio and maximum Doppler rate.
  - Acquisition time in coherent mode optimization is done by adjusting the 2 following parameters: Sweep Range and Sweep Center Frequency.
- Non Coherent Mode:
  - In non Coherent Mode, the sole concern consists in having a received signal level **3dB above threshold** (input noise density level received on CTR70)

Heritage

- More than 500 units have been sold worldwide for different purposes:
  - Antenna Manufacturers
  - Flight Test centers
  - Space Agencies
  - Space Prime contractors
  - Satellite Operators
- A range of products suited to worldwide customer requirements:
  - AIRBUS DEFENSE & Space, CNES, ECIL, ESA, ESOC, INEO, GLOBALSTAR, HAL, ISRO, ISTRAC, MT-MECHATRONIC, SSC, TELESPAZIO, THALES ALENIA Space, THALES, VERTEX, VIZADA, …
- It is because our products suit your feed design with the best available pointing accuracy, that you don’t have to customize your antenna system to our products!

Thank your for your Attention

M.Vetrivel