White Paper

CS67PLUS 100 Mb/s

Troposcatter Radio Description

Tactical Military radio needs have evolved far beyond basic voice and data communication. The latest communication equipment needs to have high throughput and be adaptable, interoperable, and light weight. Today's warfighters require broadband communication equipment capable of using different frequencies and frequency bands as well as operating with several different protocols.

The CS67Plus Tropo Radio has a software-defined adaptive architecture capable of supporting Line-of-sight (LOS), Tropo, and beyond line-of-sight (BLOS) communications with a capacity of up to 200 Mbps without data compression and over 300 Mbps with data compression. It offers a selection of modulation techniques from BPSK to 64 APSK and FEC code rates and modulations controlled thru ACM (adaptive coding and modulation) to meet the demanding throughput requirements. The CS67Plus Tropo Radio has means of monitoring its own performance and modifying its operating parameters to improve performance. It automatically adjusts the data and FEC rates based on propagation variations, while maintaining a high user throughput. Other key features include:

- Direct digital to RF modulation - No intermediate frequencies
- Highly integrated MIMO transceiver
- Higher order modulation (up to 6 bits/symbol) and data compression
- More powerful FEC – Low Density Parity Check (LDPC) Coding
- Seamless automatic ACR/ACM with user defined QoS
- Packet processor with GigE layer 2 IP features and encryption
- Adaptive equalizer with diversity gain for a given link environment
- 100:1 parts count reduction, 6:1 Size, Power, & Weight Reduction vs Current Design, 50% Cost Reduction
- MIL-Spec rugged radio & modem – IP-6x rated for Outdoor use

The figure below shows the CS67Plus Tropo Radio in a redundant configuration. The entire redundant radio fits in 1RU.

The figure on the right shows the non-redundant CS67Plus Tropo Radio module. The module uses ARINC style blind connector that allows easy replacement in the field. The radio consists of two sections. A digital section implemented in one FPGA's, and an analog section implemented entirely in two MIMO transceiver chips. The CS67Plus Radio receiver and transmitter functionality is changed by software without making any physical changes to the hardware. This structure eliminates the need for using traditional hardware, as software-based algorithms are used to select specific frequencies and architecture.

The CS67Plus Tropo Radio directly influences the cost of the entire system in several ways, reducing parts count in the RF chain, reducing the size and weight, reducing the direct labor associated with assembly and test.

The weight of tactical communication systems has always been an issue, as it can affect how quickly military personnel can set-up and move on the ground. The CS67Plus Radio has reduced size, weight, and power into one device replacing multiple pieces of equipment.

The table below show the key modem characteristics:

Description	Requirement
Radio Architecture	Single Module (non-redundant) Dual Modules (redundant)
Radio Elements	Each radio (single or dual module) include: 2 Transmit Channels 4 Receive channels 1 modem 1 reference clock
Radio Configuration	Single link Relay Two independent links
Modes of operations	LOS, BLOS, Tropo
Diversity modes	Single, Dual or Quad
Occupied 3dB Bandwidth	2.5 MHz, 5 MHz, 10 MHz, 20 MHz (user selectable)
Communications Protocol	Ethernet – Layer 2
Radio Interface (user data and M&C)	Ethernet (1000BASE-T) – Single interface
Secondary M&C Radio Interface	RS-232 (Only hardware functionally)
Tunable Filters Control	Each radio shall have the capability to control: - Up to 6 Tunable filters - RS485 Interface
GUI	Web based graphical User interface
Loop-back	Digital and RF
Internal BERT	Test mode – No user traffic Continuous average BER estimate – during user traffic
Diagnostics	Fault isolation to replaceable module level
Alarms	Major alarms, Minor Alarms
Monitor Data Storage	64 GB per radio module minimum
MTBF	100,000 hrs.
Modem Protocol	Ethernet
Symbol Rate	2.5 Msps, 5 Msps, 10 Msps, 20 Msps (user selectable)

Description	Requirement
Data Rate Modes of Operation	The modem shall support 3 modes of data rate selection - Fixed - Dynamic - Max Throughput
Latency	The modem data latency shall be as follows: - Fixed data rate: ≤ 5 ms - Dynamic data rate: ≤ 30 ms - Max Throughput: ≤ 100 ms
FEC	Low Density Parity Check (LDPC)
Modulation	BPSK to 64 APSK automatic select
ACM/ACR	Automatic/Hitless
Data Rate	Automatic or User selectable (see rate table)
Channel Characteristics	Instantaneous: AWGN Average: Rayleigh with dispersion
Data Compression	AHA3602C GZIP File Format Specification version 4.3 (RFC-1952)
Encryption	AES-256 – Optional Payload Encryption
Power Consumption	25 W maximum (single module)

Available user selectable data rates for each of the symbol rates (channel bandwidths) are derived from the MODCOD table shown below.

Mod/Cod	Bps	FEC	Aggregate Data Rates (Mbps)			
			20 Msps	10 Msps	5 Msps	2.5 Msps
0	1	0.5	10.0	5.0	2.5	1.3
1	2	0.5	20.0	10.0	5.0	2.5
2	2	0.55	22.0	11.0	5.5	2.8
3	2	0.6	24.0	12.0	6.0	3.0
4	2	0.625	25.0	12.5	6.3	3.1
5	2	0.65	26.0	13.0	6.5	3.3
6	2	0.675	27.0	13.5	6.8	3.4
7	2	0.7	28.0	14.0	7.0	3.5
8	2	0.75	30.0	15.0	7.5	3.8
9	3	0.533	32.0	16.0	8.0	4.0
10	3	0.55	33.0	16.5	8.3	4.1
11	3	0.575	34.5	17.3	8.6	4.3
12	3	0.6	36.0	18.0	9.0	4.5
13	3	0.625	37.5	18.8	9.4	4.7
14	3	0.65	39.0	19.5	9.8	4.9
15	3	0.675	40.5	20.3	10.1	5.1
16	3	0.7	42.0	21.0	10.5	5.3
17	3	0.725	43.5	21.8	10.9	5.4
18	3	0.75	45.0	22.5	11.3	5.6
19	4	0.6	48.0	24.0	12.0	6.0
20	4	0.625	50.0	25.0	12.5	6.3
21	4	0.65	52.0	26.0	13.0	6.5
22	4	0.675	54.0	27.0	13.5	6.8
23	4	0.7	56.0	28.0	14.0	7.0
24	4	0.725	58.0	29.0	14.5	7.3
25	4	0.75	60.0	30.0	15.0	7.5
26	4	0.775	62.0	31.0	15.5	7.8
27	4	0.8	64.0	32.0	16.0	8.0
28	5	0.675	67.5	33.8	16.9	8.4
29	5	0.7	70.0	35.0	17.5	8.8
30	5	0.725	72.5	36.3	18.1	9.1
31	5	0.75	75.0	37.5	18.8	9.4
32	5	0.775	77.5	38.8	19.4	9.7
33	5	0.8	80.0	40.0	20.0	10.0
34	5	0.82	82.0	41.0	20.5	10.3
35	5	0.85	85.0	42.5	21.3	10.6
36	5	0.875	87.5	43.8	20	10
37	5	0.9	90.0	45.0	21	11
38	6	0.675	81.0	41	22	11
39	6	0.7	84.0	42	23	11
40	6	0.725	87.0	44	23	12
41	6	0.75	90.0	45	24	12
42	6	0.775	93.0	47	25	12
43	6	0.8	96.0	48	26	13
44	6	0.82	98.4	49	26	13
45	6	0.85	102.0	51	27	14
46	6	0.875	105.0	53		
47	6	0.9	108.0	54		