CLO-10 Link Optimizer
DoubleTalk® Carrier-in-Carrier®
Bandwidth Compression

INTRODUCTION

Comtech EF Data's CLO-10 Link Optimizer is yet another industry first, providing up to 10 MHz of modem agnostic bandwidth compression that can be used to optimize one or more two-way satellite links.

CLO-10 is based on DoubleTalk® Carrier-in-Carrier® bandwidth compression technology that allows for two-way satellite links to be transmitted concurrently in the same transponder space, thereby providing significant savings in space segment.

Operating at 70/140 MHz IF, CLO-10 can be easily deployed between the frequency up/down converters and the modem or the transceiver and the modem.

DoubleTalk Carrier-in-Carrier technology is not just limited to providing space segment savings. It enables multi-dimensional link optimization, thereby allowing satellite communications users to:

- Reduce operating expenses (OPEX)
- Reduce total capital expenses (CAPEX) by allowing a smaller BUC/HPA and/or antenna
- Increase throughput without using additional transponder resources
- Increase availability without using additional transponder resources
- Or, a combination to meet specific user needs

KEY FEATURES

- DoubleTalk Carrier-in-Carrier bandwidth compression
- Up to 10 MHz cancellation bandwidth
- Single link or multi-link optimization
- Frequency: 50 MHz – 90 MHz or 100 MHz –180 MHz, 1 kHz steps
- Simple setup
- M&C: Front Panel, EIA-232/485 Remote Port, and 10/100BaseT Ethernet with Telnet, SNMP (future) and http (future) support

DOUBLETALK CARRIER-IN-CARRIER BANDWIDTH COMPRESSION

DoubleTalk Carrier-in-Carrier is based on patented bandwidth compression technology originally developed by Applied Signal Technology, Inc. Using "Adaptive Cancellation" it allows transmit and receive carriers of a two-way link to share the same transponder space.

Figure 1 shows the traditional full-duplex satellite link, where the two carriers are adjacent to each other. Figure 2 shows the typical DoubleTalk Carrier-in-Carrier operation, where the two carriers are overlapping, thus sharing the same spectrum.

Figure 1. Traditional Duplex SCPC Link

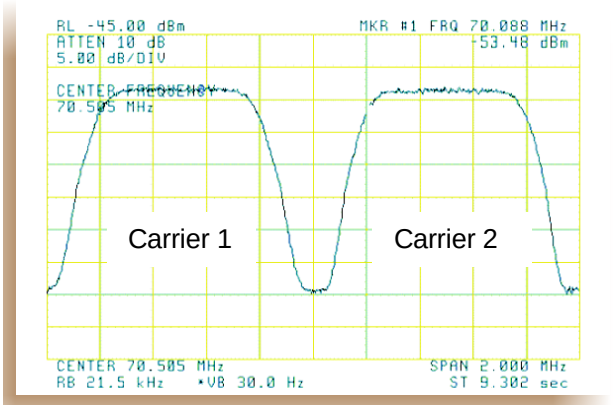
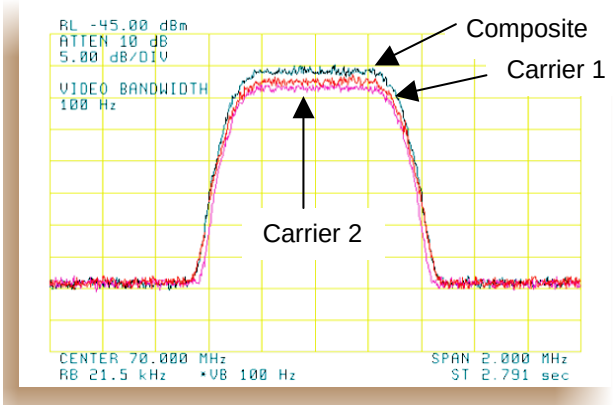


Figure 2. Duplex SCPC Link With DoubleTalk Carrier-in-Carrier



DoubleTalk Carrier-in-Carrier is complementary to all advances in modem technology, including advanced forward error correction (FEC) and modulation techniques. As these technologies approach theoretical limits of power and bandwidth efficiencies, DoubleTalk Carrier-in-Carrier utilizing advanced signal processing techniques provides a new dimension in bandwidth efficiency.

Bandwidth Optimaztion

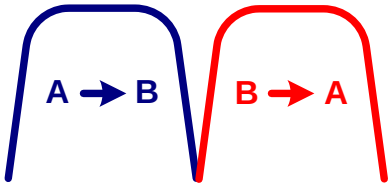
CLO-10 Link Optimizer – DoubleTalk® Carrier-in-Carrier® Bandwidth Compression

DoubleTalk Carrier-in-Carrier can allow satellite users to achieve spectral efficiencies (i.e. bps/Hz) that cannot be achieved with traditional links. For example, DoubleTalk Carrier-in-Carrier used with a pair of 16-QAM carriers achieves the bandwidth efficiency of 256-QAM (8bps/Hz) with the power efficiency closer to that of 16-QAM. This allows DoubleTalk Carrier-in-Carrier to not only provide significant OPEX savings, but also reduce total CAPEX by allowing a smaller BUC/HPA and/or antenna.

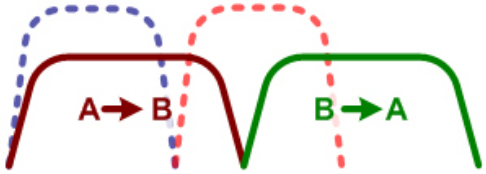
DoubleTalk Carrier-in-Carrier can be successfully deployed in bandwidth-limited as well as power-limited scenarios. Combining DoubleTalk Carrier-in-Carrier with advanced FEC techniques such as Turbo Product Codes (TPC) or Low Density Parity Check Codes (LDPC) can recover enough power that can then be traded for bandwidth.

In addition, in power-limited scenarios, signal spreading can be used to recover power that can then be traded for bandwidth to achieve transponder savings. The following example illustrates the process for implementing DoubleTalk Carrier-in-Carrier in a power-limited scenario (savings for a typical C-band satellite link):

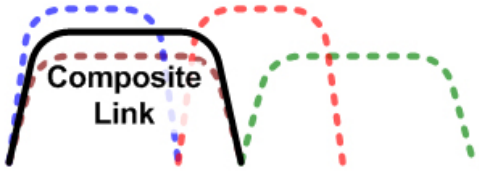
The conventional link is using 8-PSK, TPC 3/4:



Spread the signal by switching to a lower order modulation and/or FEC code – say QPSK, TPC 7/8. This increases the total transponder bandwidth by 28.5%, while reducing the total transponder power by almost 40%:



Now using DoubleTalk Carrier-in-Carrier, the second QPSK, TPC 7/8 carriers can be located on top of the first carrier – thereby reducing the total transponder bandwidth by about 36% and total transponder power by about 38% when compared to the original side-by-side 8PSK, TPC 3/4 carriers.



CANCELLATION BANDWIDTH TIERS

The CLO-10 is available in 5 different cancellation bandwidth tiers:

- 1.024 MHz
- 2.048 MHz
- 4.096 MHz
- 8.192 MHz
- 10 MHz

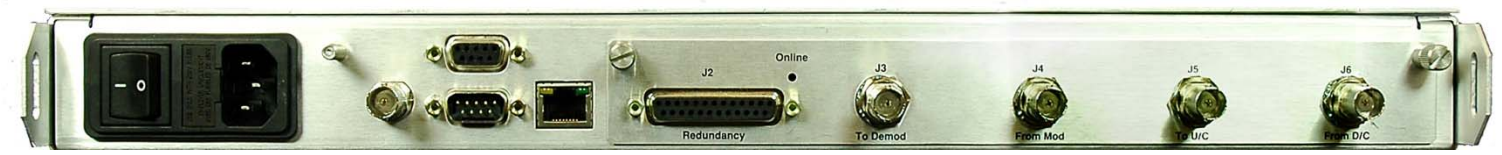
To meet changing needs, the bandwidth tiers can be upgraded in the field using FAST codes purchased from Comtech EF Data.

MONITORING & CONTROL

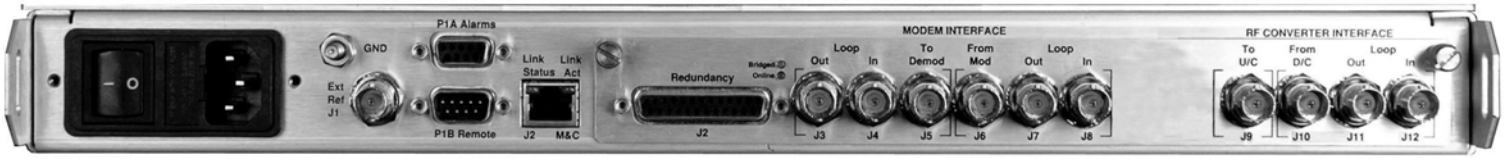
The CLO-10 provides a range of options for local and remote management. It can be managed via the front panel, the remote M&C port (EIA-232/EIA-485), or the 10/100BaseT Ethernet port. With support for Telnet, SNMP (future) and http (future), the CLO-10 can be integrated into an IP-based management system.

REDUNDANCY

The CLO-10 supports 1:1 and 1:N redundancy using Comtech EF Data's patented distributed Daisy Chain Redundancy scheme. This eliminates the need for an external controller/switch.



CLO-10 Rear View (Without Optional Redundancy Module)



CLO-10 Rear View (With Optional Redundancy Module)

SYSTEM SPECIFICATIONS

Cancellation Bandwidth	Up to 10.0 MHz
Signal Cancellation	30 dB minimum with like carriers
BER Degradation	0.3 dB (typical) when used with Comtech EF Data Modems Interfering carrier(s) at or below +10 dBc Adjacent carrier(s) at or below +13 dBc
Input Frequency	50 MHz – 90 MHz or 100 MHz –180 MHz 1 kHz steps
Input Level, Uplink (From Modem)	0 to -40 dBm Reference Carrier +10dBc Maximum Composite
Input Level, Downlink (From Downconverter)	-105 dBm + 10 log(BW) to -70 dBm + 10 log(BW) BW is input signal processing bandwidth, usually set to the symbol rate of the desired signal 94 - 10 log(BW) dBc maximum composite +20 dBm absolute maximum composite
Output Frequency	50 MHz – 90 MHz or 100 MHz –180 MHz 1 kHz steps
Output Level, Uplink (To Upconverter)	Input Level (Uplink) - 1 ± 0.5dB
Output Level, Downlink (To Modem)	-20 to -30 dBm for C/I of ±10dB
Uplink - Output spurs, Stability, Spectrum	Set by the modem
Frequency Reference	Selectable
Internal Reference	10 MHz, ±1.5 ppm stability
External Ref (BNC Female)	None (off), 1, 2, 5, or 10 MHz, internally phase locked. Input is 50 / 75 Ω compatible with 0.5 to 4.0 V pp sine or square wave. Requires high stability source.
Input/Output impedance	75 Ω
Unit Fault	Form C Relay
Redundancy	1:1 and 1:N (*Covered by US Patent 5,666,646 - Radio frequency (RF) converter system with distributed protection switching and method therefore*)
Satellite Restrictions	Satellite in "loop-back" mode (i.e. Transmit station must be able to receive itself) "Non-processing" satellite (i.e. does not demodulate/remodulate the signal)

AVAILABLE OPTIONS

2.048 MHz Cancellation BW	FAST Option
4.096 MHz Cancellation BW	FAST Option
8.192 MHz Cancellation BW	FAST Option
10.0 MHz Cancellation BW	FAST Option

MONITORING & CONTROL

Remote Port	EIA-232/485
10/100 Base-T Ethernet	Telnet SNMP (future) http (future)
Reflash	Via ftp

Test Functions

Pass-through	Signal from Downconverter passes through the signal processing chain with no cancellation applied (Canceller disabled). This is useful when bringing up a link initially with a single carrier.
Loopback	Similar to Pass-through except the uplink signal is routed to the Demodulator. No cancellation is applied.
Dual Carrier CW Test	A 1010… Double Sideband Suppressed carrier pattern is output from the Rx OUT port. This is useful for evaluating the carrier suppression of the Re-modulator.
Single Sideband CW	Similar to Dual Carrier CW except a single sideband carrier is transmitted. Sideband suppression indicates amplitude and quadrature balance of the re-modulator.
CW	Modulation is disabled and CW signal is transmitted

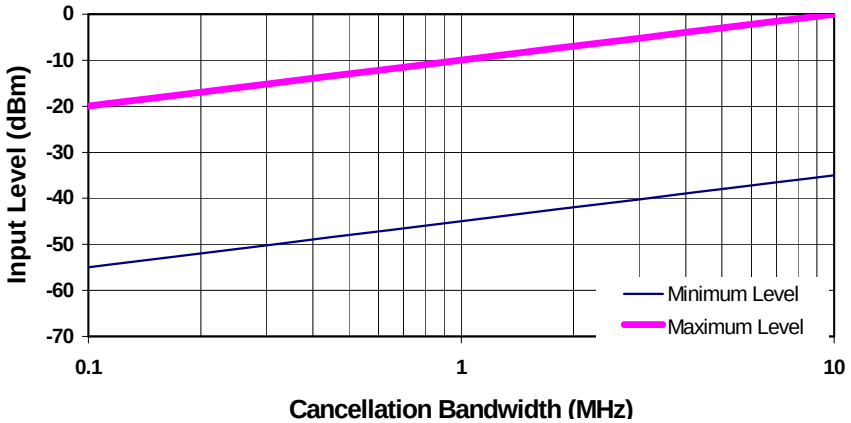
REGULATORY

CE Mark	EMC Safety
FCC	Part 15

ENVIRONMENTAL AND PHYSICAL

Temperature	Operating: 0 to 50ºC (32 to 122°F)
	Storage: -25 to 85ºC (-13 to 185ºF)
Power Supply	100 to 240 VAC, 50/60 Hz, Auto sensing -48 VDC (option)
Power Consumption	< 50W (Typical)
Physical Dimensions (1RU)	1.75H x 19.0W x 18.65D inch (4.4H x 48W x 46.8D cm) approximate
Weight	< 10 lbs (4.5 kg) approximate

Input Level vs Signal Bandwidth



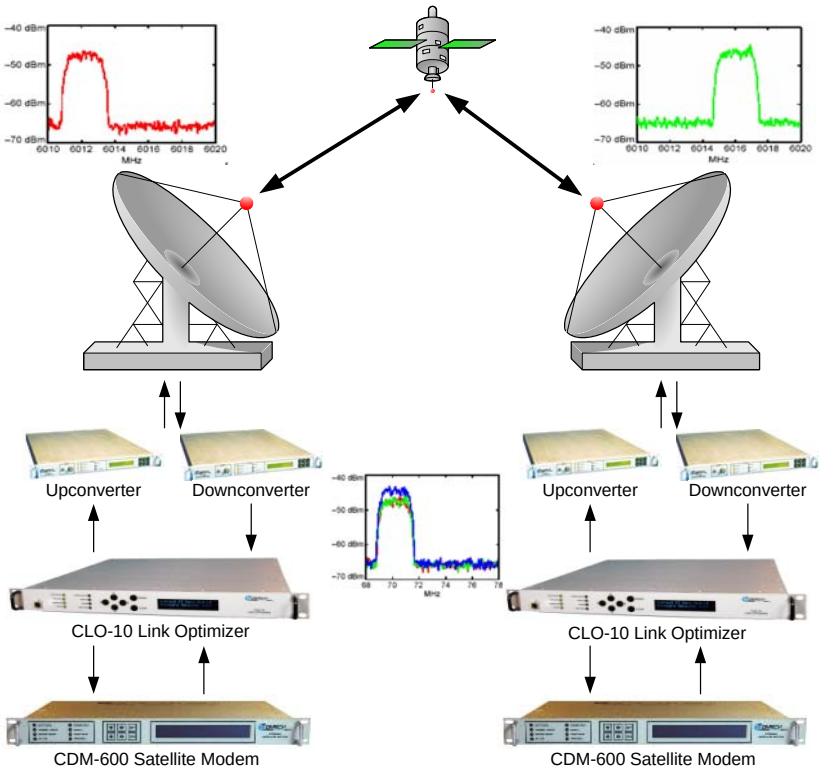


Figure 3. Full Duplex Link Using CLO-10

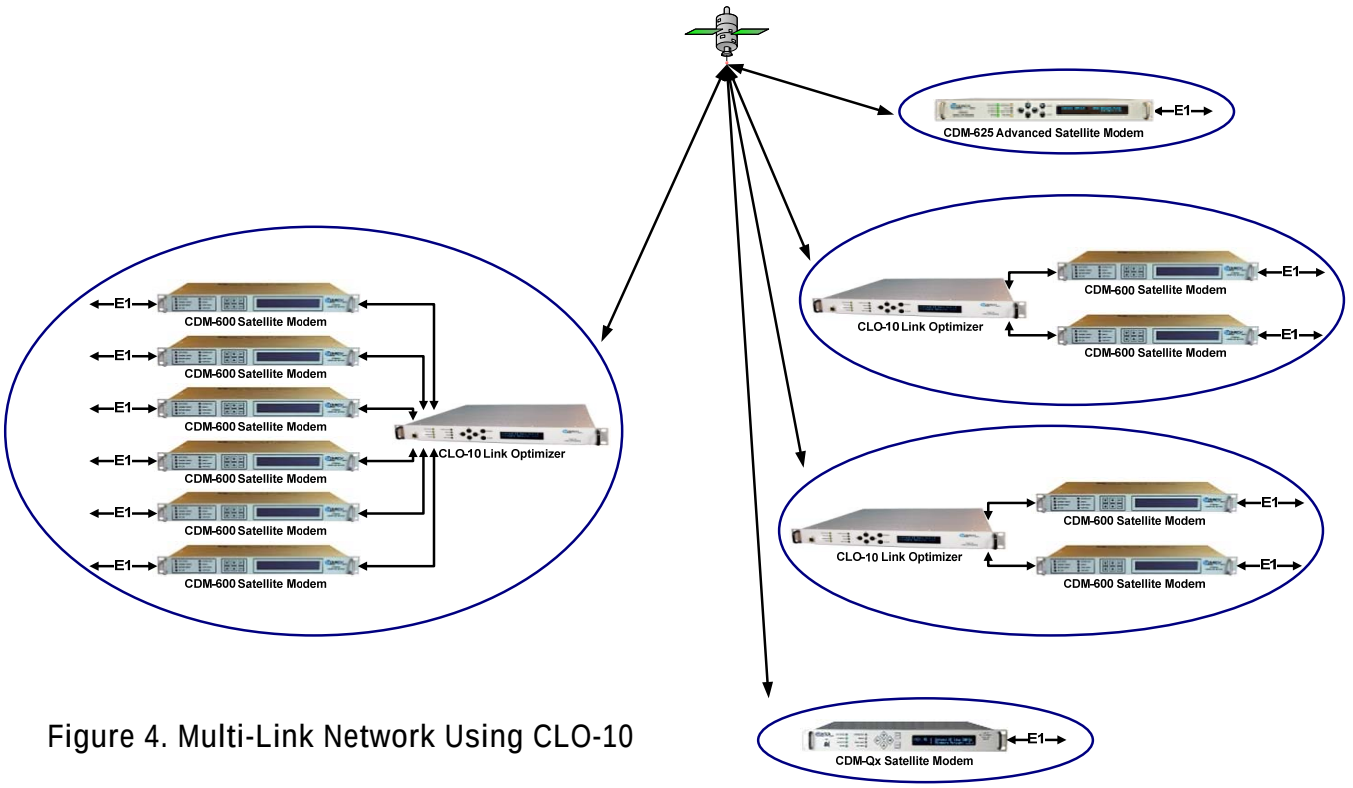


Figure 4. Multi-Link Network Using CLO-10

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