

## POWER LINE CARRIER



## UCC 2021

### SPECIAL FEATURES

- Flexibility for upgrade of existing PLC networks (100% compatible with existing PA and Line Interface modules of Analog GE PLC equipments)
- Interconnection between a Power Line Carrier and any existing or new E1/T1 Network
- IEC-495 and G.703 standards exceeded.
- Single Side Band modulation under Signal Processing by DSP, NCO, DUC (Digital Up Converter), DDC (Digital Down Converter), latest technology devices.
- AF and y RF functionality 100% programmable through a Windows® Interface.
- Line interface filter response selectable by jumpers for the whole frequency range.
- One and Two Channel PLC equipment with Power Output of 50 Watts.
- Hardware, 100% modular.
- Versatility in setup and commissioning.

## INTRODUCTION

PLC de Venezuela S.A., using the most efficient General Electric Technology has had available for long time a full line of Single Sideband PLC equipment, consisting of single, dual or 4-Channel equipment in various configurations. This long experience in Power Line Carrier Systems has been used to design the UCC Plexor Series (Universal Communications Center), a highly integrated and State of the Art PLC equipment incorporating Digital Technology to increase its reliability and flexibility, as well as mechanical arrangement for easier installation and maintenance. This function include a wide range of Equipment terminals of several power output levels, together with many optional features to accommodate analog, digital E1/T1, as well as the H.100 standard for Digital Telephony channels to facilitate integrated system communication design. Drop and Insert channels to share between analog, digital E1/T1 and Digital Telephony, makes stronger and flexible equipment.

The frequency range of the equipment is 20 Khz to 500 Khz so that the advantages of SSB modulation can be used for most efficient spectrum utilization. The high quality in adjacent channel selectivity, idle channel noise, crosstalk and spurious output, contribute considerably to the performance of this single sideband system, as well as the frequency stability over the specified temperature range. For higher reliability the components are burned-in, to virtually eliminate infant mortality failures. All RF output and input circuits meet the IEEE SWC transient withstand test which involves 3000 Volts at 1.5 MHz. This is a significant characteristic for equipment operating in the hostile climate of Electric utility systems.

## MODULATION SCHEME

The most recent improvements asserted in the new UCC Plexor Series terminals, are oriented to the practical and easy frequency planning and customization of SSB equipment in site, involving full RF & Audio field programming.

The latest digital devices such as the DUC allows one step modulation from Audio level to RF, and the DDC allows one step demodulation from RF to Audio level at a pace of 2.5 Khz, 4.0 Khz, 8 Khz or 16 Khz as shown in the example for the modulation scheme in Figure 1. For the purpose of the diagram each 0-4 Khz block represents a single audio channel, and each channel can be utilized in many different ways as covered under Application Notes. To conserve spectrum, each such channel is positioned side by side in a frequency spectrum for a multichannel application. Contiguously spaced channels are available with the UCC.

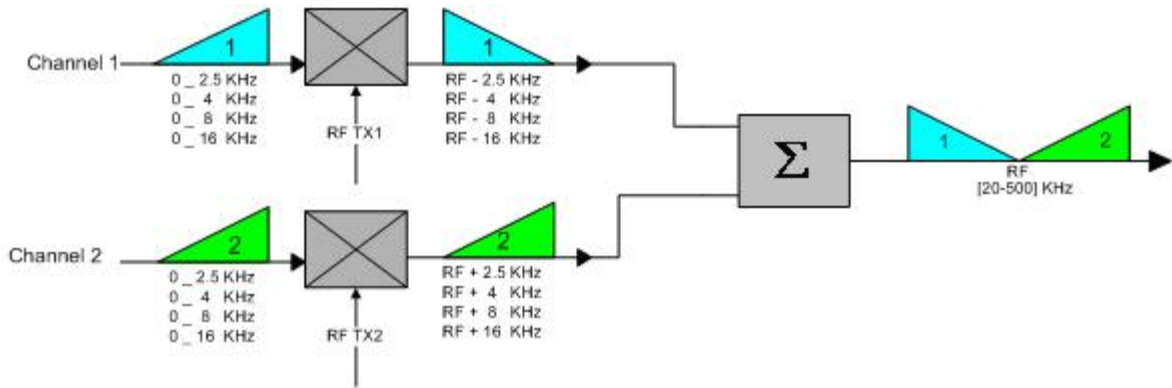


Figure 1. Modulation scheme

## CHANNEL UTILIZATION

Figure 2 shows some of the combinations of functions that can be applied within each 0 to 4 KHz channel in a single sideband system. It is obvious from these diagrams that many other combinations are possible which gives considerable flexibility in the utilization of single sideband. This channel share both voice and telecontrol signals, it will be implemented in channels 1 & 2. The telecontrol signals are representative of a Multi-tone system.

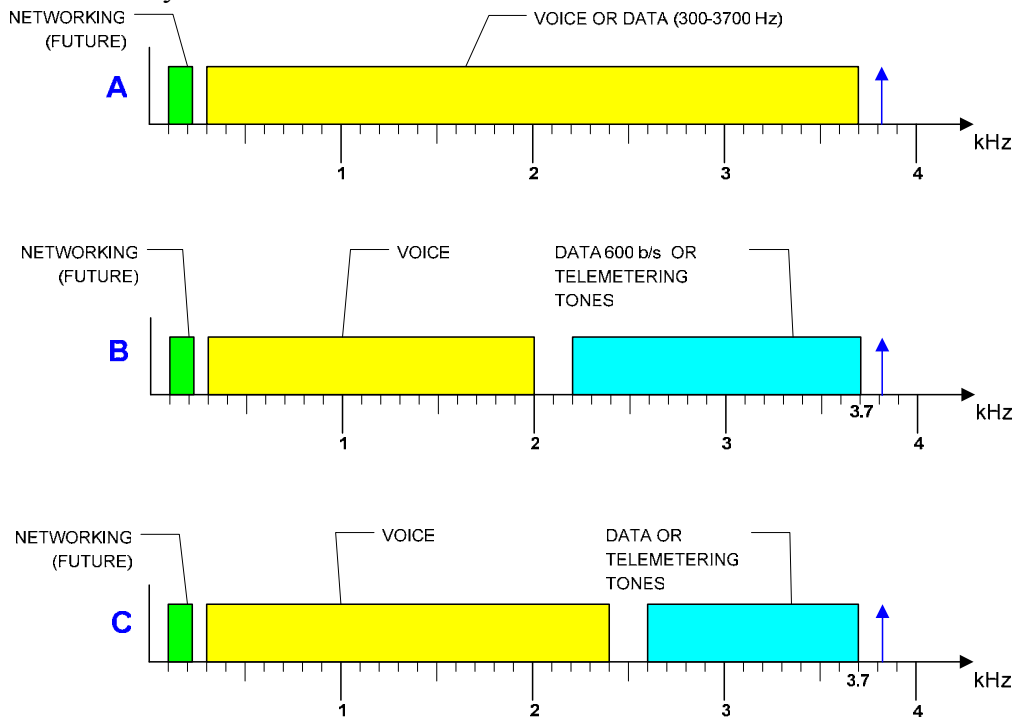


Figure 2. Channel Utilization

## SYSTEM ARCHITECTURE

The modularity of the UCC (Plexor Series) allows high flexibility to comply with different requirements; the main modules are:

- PA – POWER AMPLIFIER
- LINE INTERFACE
- TRANSCEIVER

### POWER AMPLIFIER

Is a 50W balanced linear power amplifier which will be optionally used with another one to provide 100W power transmission.

### LINE INTERFACE

This 3U shelf contains the following internal modules:

- Balance Board: Used to combine the two 50W amplifiers
- Transient filter: 20-500 kHz programmable (jumper selectable) TX filter
- Front End Filter: 20-500 kHz programmable (jumper selectable) RX filter.
- Line Board: Contains the skewed hybrid, impedance matching and Rx adjustable attenuator.

### TRANSCEIVER

Is the digital processing module which contains the following modules:

- 4W E&M interface: Allows interconnection to external PABX or 4W data modem
- FXS/FXO: Allows interconnection to external 2 wire telephone or 2W telephone trunk.
- TELEPROTECTION: Provides up to 4 trips commands located in one 4 kHz channel.
- E1: Provides interface to an existing or future E1 trunk to be transferred (as maximum four 64kbps voice channels) to the PLC link.
- XCVR PROCESSOR: Implements the digital filtering of the channels and the channel mapping. Each XCVR processor will allocate up to two 4kHz channels and a maximum of two XCVR processors boards will operate on one UCC2021 equipment.

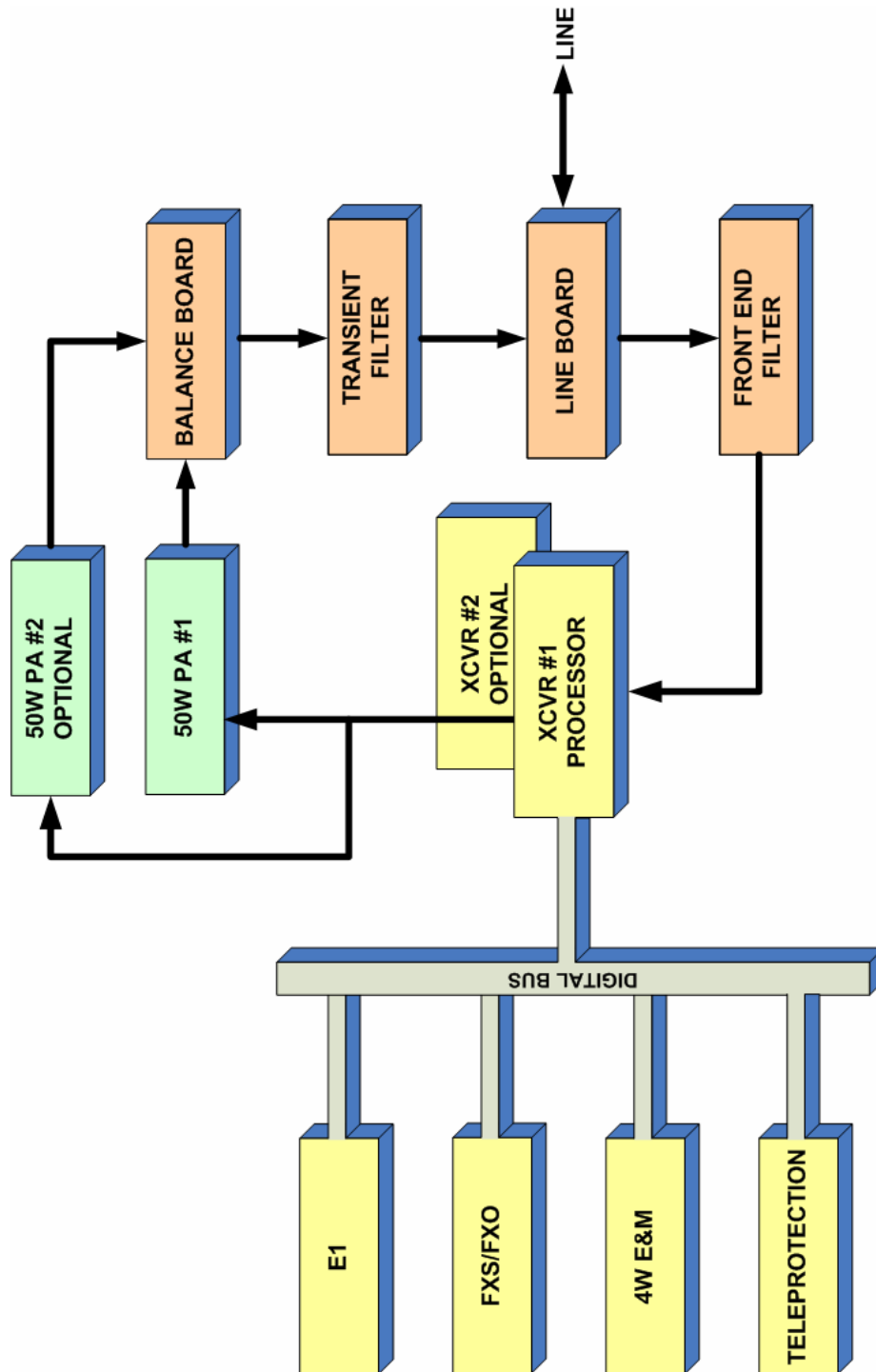


Figure 3. System Architecture

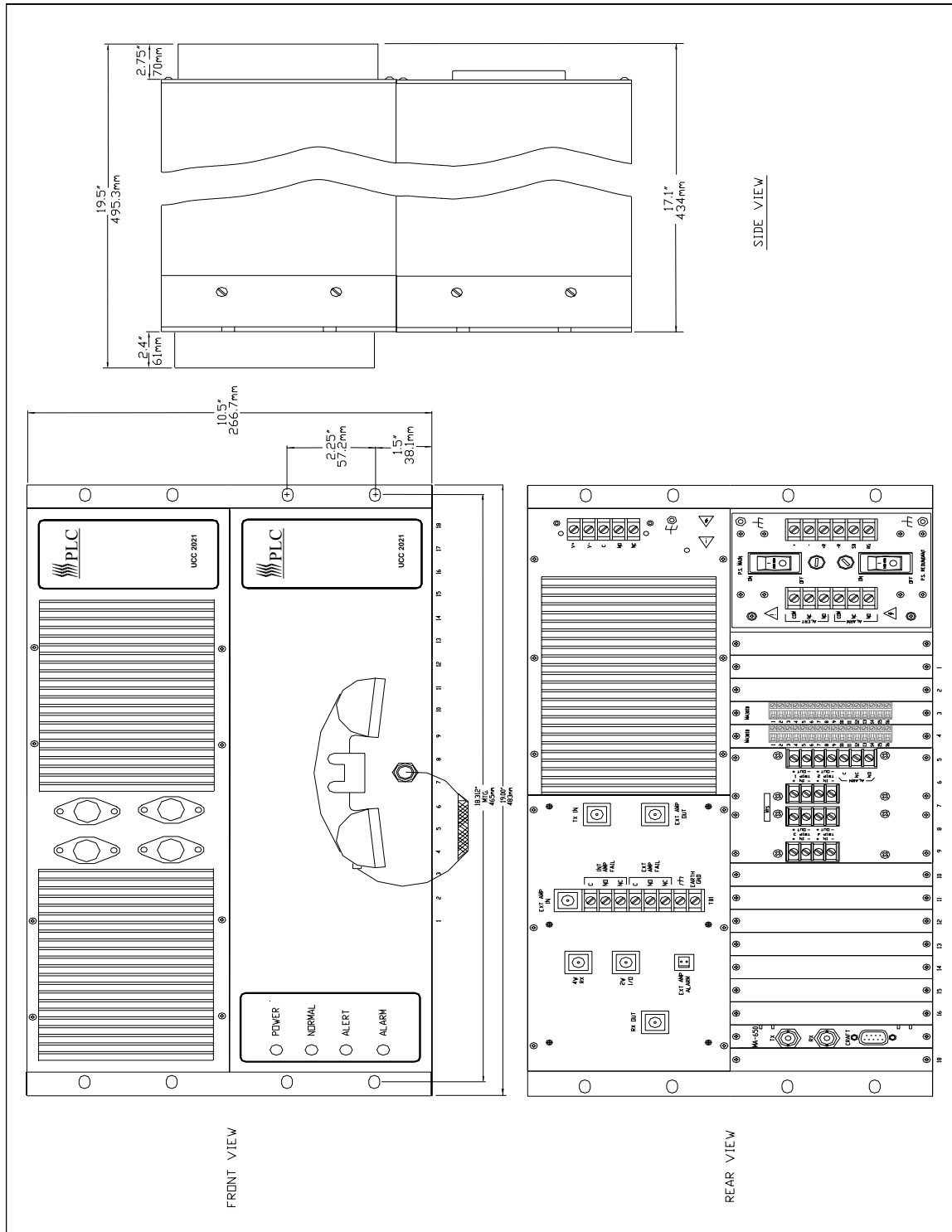


Figure 4. Chassis dimensions

## TELEPROTECTION INTERFACE

F6 teleprotection is a single tone system in that it sends only one tone at a time, making it ideal for PLC. Different combinations of inputs use a priority scheme to generate the correct tone and the correct output on the receiving side. This system can have 2, 4 or 8 inputs and outputs which are programmable as follows. Each input can be inverted or not and if 8 inputs are employed, paired inputs can be AND'ed or OR'ed to form each of the 4 command inputs.

Once the input commands have been determined, the transmitted command is determined according to the priority chart. Two charts are available, based on the mode setting, "2+2" or "3+1". The following charts are used. The 2+2 mode is typically used for parallel line applications, while the 3+1 mode is typically used for single pole trip applications.

Input Command	TX Command (actual TX)	Frequency (2/coded)	Receiver outputs
No Input	None	3840	None
No input	Test	F1	None
A	A	F3	A
B	B	F5	B
A&B	A&B	F7	A&B
C	C	F2,F4	C
D	D	F2,F6	D
C&D	C&D	F4,F6	C&D
A&D	A&D	F6,F8	A&D
B&C	B&C	F4,F8	B&C
A&C	C	F2,F4	C
B&D	D	F2,F6	D
A&B&C	B&C	F4,F8	B&C
A&B&D	A&D	F6,F8	A&D
A&C&D	C&D	F4,F6	C&D
B&C&D	C&D	F4,F6	C&D
A&B&C&D	C&D	F4,F6	C&D

Table 1 Command Priority Table for "2+2" Mode

The transmitted command is sent to the PLC transceiver after an appropriate de-bounce period.

Depending on the mode and the command, the transceiver sends one frequency for the entire time or switches back and forth between two frequencies. The single frequency is considered un-coded operation. Un-coded is less secure and is used for permissive applications. Coded transmission consists of two frequencies sent one after the other for a specified time. The receiver must receive each tone for a specified time period before declaring a valid trip reception.

Once the receiving DSP has determined that a valid trip has been received, the RX trip command is sent to the MTS where it is decoded into output contacts according to a user setup similar to that for the inputs.

Input Command	TX Command (actual TX)	Frequency (2/coded)	Receiver outputs
No Input	None	3840	None
No input	Test	F1	Test
A	A	F3	A
B	B	F5	B
A&B	D	F2,F6	D
C	C	F7	C
D	D	F2,F6	D
C&D	D	F2,F6	D
A&D	D	F2,F6	D
B&C	D	F2,F6	D
A&C	D	F2,F6	D
B&D	D	F2,F6	D
A&B&C	D	F2,F6	D
A&B&D	D	F2,F6	D
A&C&D	D	F2,F6	D
B&C&D	D	F2,F6	D
A&B&C&D	D	F2,F6	D

**Table 2 Command Priority Table for "3+1" Mode**

## ADDITIONAL FEATURES

### *Selectable unblock logic*

In the event that the receiver enters an alarm state, the outputs programmed for unblocking will go active after 20 mS and will remain active for 150 mS.

### *Integrated SOE*

The Teleprotection interface stores up to 100 events including; Time/Date, Address signal fail, CRC errors, Input/Output contact status, and Channel Delay (Ping-Pong)

### *Trip Counters*

Trip counters are available to record how many times each command is sent or received. The counters roll over after 255 counts.

### *Integrated Test Switch*

The Teleprotection interface supports the connection of an integrated test panel. The test panel can be mounted inside the door of the UCC-2021. The test panel has a 5 position rotary switch, a pushbutton, and a toggle switch. The rotary switch has Normal, Input #1, Input #2, Input #3 and Input #4 positions.

Selecting Input 1 through 4 positions will not do anything until the pushbutton will send the command corresponding to the selecting position.

The toggle switch disables the local outputs.

## MAN MACHINE INTERFACE

A Windows program allows the UCC to configure all the parameters like the Channel mapping for the SSB/E1/T1/H.100, load the carrier frequency to the NCO, output power level, as well as to measure the SNR, Alarms, etc..

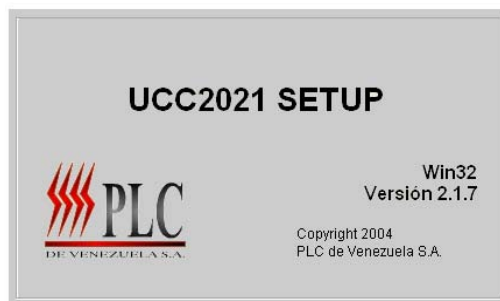


Figure 5. MMI start up screen

The channel configuration will be performed easily and graphically through screens as the following:

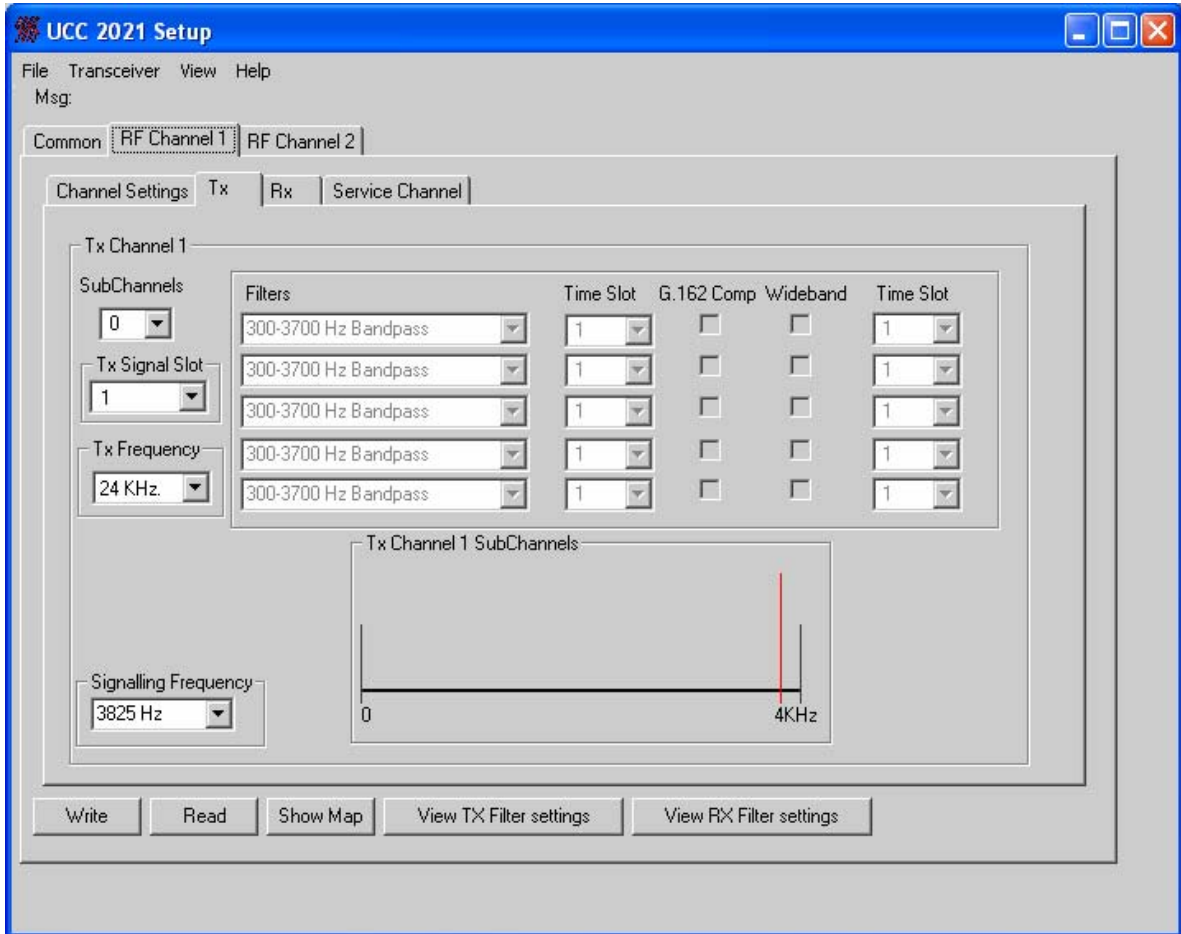


Figure 6. Configuration screen

## APPLICATIONS

The UCC (Plexor Series) has been designed to satisfy all the requirements for a Power Line Carrier System, and by means of the Drop and Insert feature the UCC integrates a Power Line Carrier channel with a Digital E1 or T1 frame, either Fiber Optic or Electrical Interface. The data Transmission, voice, telemetry, as well as teleprotection functions can be adapted to any existing Power Line Carrier System by suitable interfaces in 2 or 4 wires, with or without signaling, direct connection to any standard modem, fax, PABX or telephone available in the market. A typical Power Line Carrier application is illustrated in the following figure:

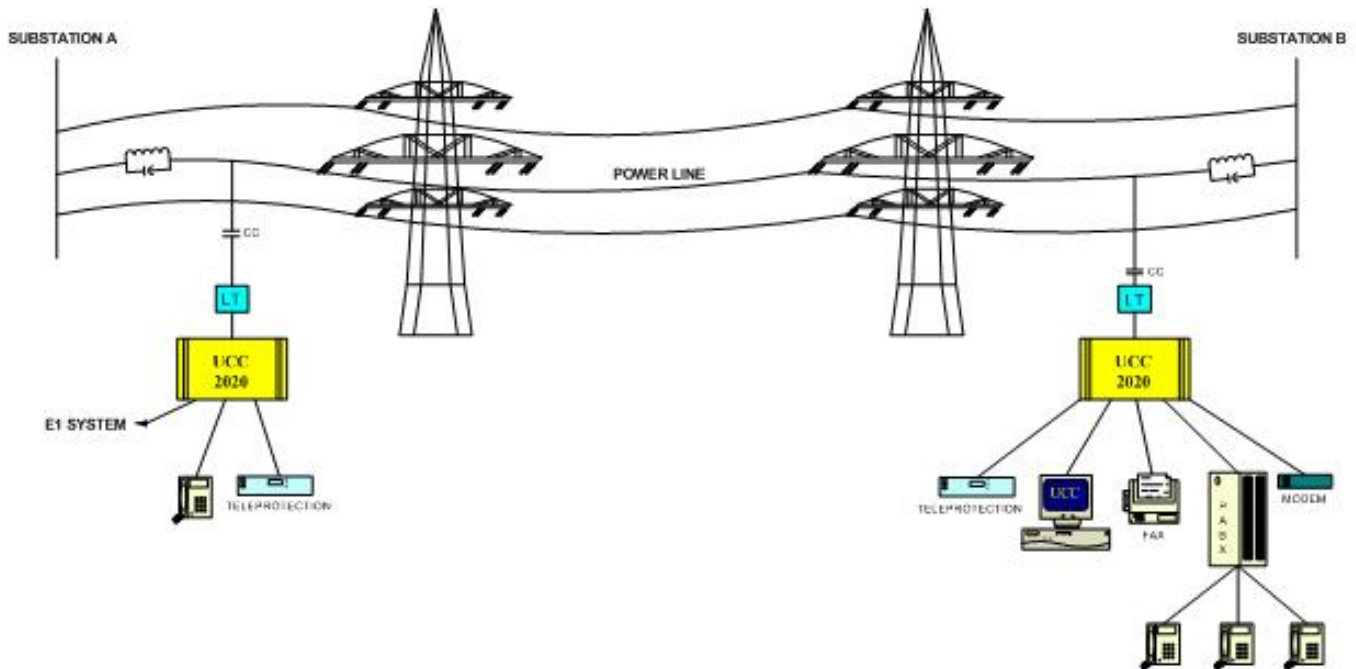


Figure 7 Typical Applications

According to figure 7 the UCC can be applied in several configurations such as:

- Channel 1, SSB link between Substations B and C.
- Channel 2, SSB link, between A and C, digitally repeated at B.
- Channel 3, E1 link between B and D.
- Channel 4, E1 link between B and D, repeated in SSB from B to A.

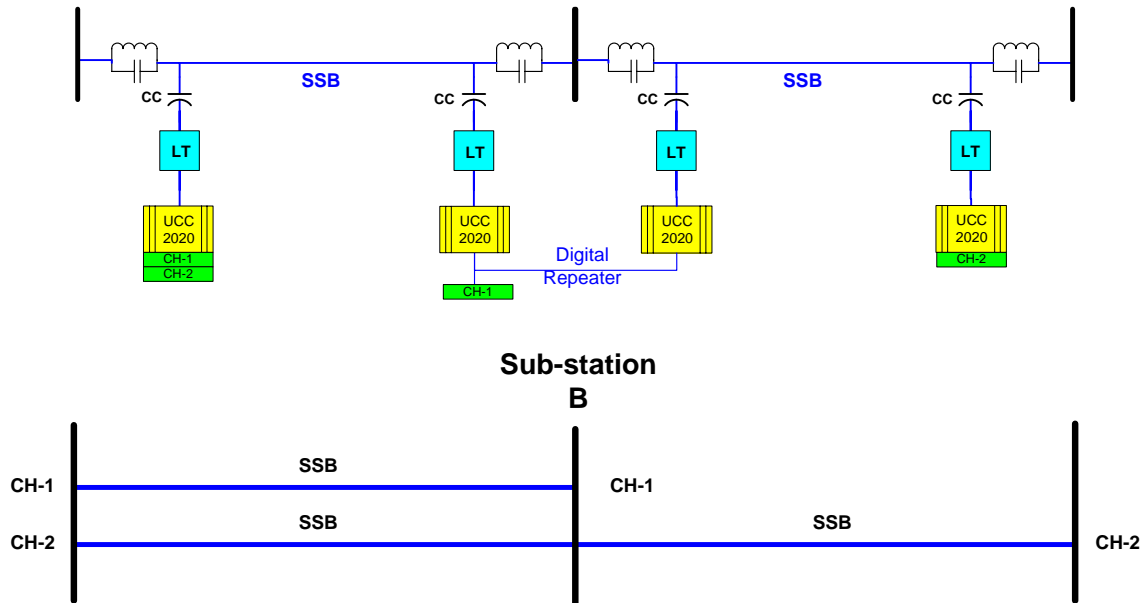


Figure 8 UCC with Digital repeater

### The UCC as a Digital Repeater

Digital repeaters offer a distinct economic advantage over audio repeaters because a digital repeater is done digitally at 2 MBPS avoiding the DAC & ADC process. Some others configurations will be implemented performing a mixture between digital systems like E1 and PLC.

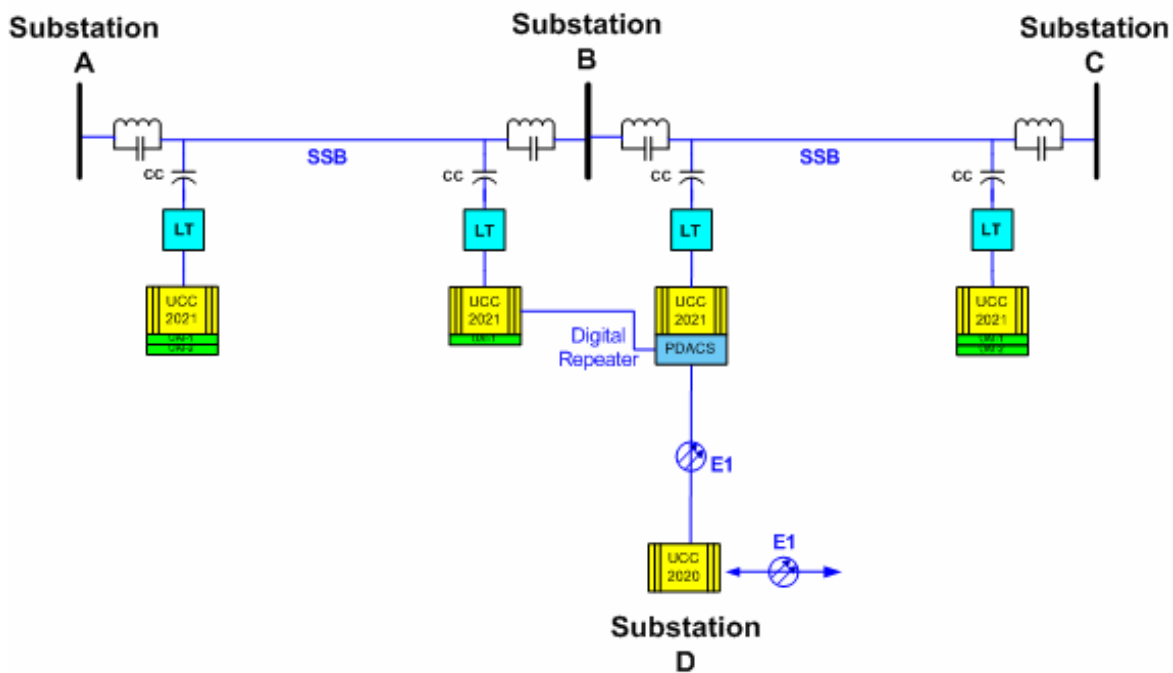


Figure 9- UCC 2021 digitally interfaced with an E1 system

## TECHNICAL SPECIFICATIONS

### ENVIRONMENTAL CONDITIONS

Ambient Temperature Range .....-20 to + 65°C  
 Relative Humidity .....0 to 95% non condensing

### RF BAND

Frequency range .....20 – 500 kHz  
 Full duplex Channels.....2 per Transceiver (up to 4 SSB CH per  
 Terminal)  
 Channel Bandwidth.....2.5 kHz, 4 kHz  
 Power output .....50, 100 Watt PEP  
 Coupling Impedance .....50, 75, 125 Ω unbalanced, 150 Ω Balanced  
 Selectivity  
     Overall (4 kHz from Bandedge)..... ≤ -75 dBmO  
     Channel (0.3 kHz from Bandedge)..... ≤ -65 dBmO

### AF BAND

AGC dynamic range.....+14 to -26 dB (IEC 495 recomm)  
 Background Noise.....≤ -55 dBm0p (IEC 495 recomm)  
 Harmonic Distortion.....≤ -40 dBmO F=400 Hz (IEC 495 recomm.)  
 Group Delay .....300/3400 Hz (IEC 495 recomm.)  
 Frequency Stability .....± .5 Hz at 250 kHz (±2 ppm)  
 Tx Line Filters.....Adjustable from 20 to 500 kHz  
 Rx Line Filters.....Adjustable from 20 to 500 kHz  
 Minimum sensitivity .....-30 dBm

### SIGNALLING

Frequency .....3825 Hz, optional inband  
 Type of Modulation.....FSK  
 Frequency Shift .....± 30 Hz from channel center frequency

## **TELEPROTECTION INTERFACE**

<i>Seismic Withstand</i>	TBD
<i>Input / Output Voltage</i>	operating voltage range:
48 Vdc	38-60 Vdc
125 Vdc	88-150 Vdc
250 Vdc	200-280 Vdc
Input threshold	1/2 nominal station battery

### *Solid-State Outputs*

Maximum continuous output current	1 Amp
Minimum output current	20 mA
Maximum open circuit voltage	280VDC
Maximum turn on delay	100 $\mu$ S

### *Optional Relay Outputs*

Maximum continuous output current	1 Amp (inductive)
Maximum surge current (100ms)	30 Amp
Maximum Breaking Current	1A (resistive)
Maximum open circuit voltage	280VDC
Maximum operate time	5 mS

ESD Withstand	C37.90.3
RFI Withstand	C37.90.2
SWC Withstand	C37.90.1 (Power and Alarm inputs only)
Dielectric Withstand	2500 VDC (Power and Alarm inputs only)

### *Alarm Relay*

Output Form	“C” (spdt)
Open Circuit Voltage	300 VDC
Current (continuous)	1 AMP
Breaking Current	1 AMP, Non-inductive

## **PERFORMANCE ESPECIFICATIONS**

Security, dependability and trip time are all defined by IEC 60834-1 in the following table.

Protection Scheme	Max. Trans. Time (ms)	Channel Quality S/N (dB)	Noise Duration Tb ms	Security Puc	Dependability Pmc
Blocking	15	6	Continuous	n/a	1.E <sup>-03</sup>
Blocking	15	Worst Case	200	1.E <sup>-03</sup>	n/a
Permissive Underreach	20	6	Continuous or pulsed	n/a	1.E <sup>-02</sup>
Permissive Underreach	20	Worst Case	200	4.E <sup>-03</sup>	n/a
Permissive Overreach	23	6	Continuous or pulsed	n/a	1.E <sup>-03</sup>
Permissive Overreach	20	Worst Case	200	1.E <sup>-03</sup>	n/a
Intertripping	40	6	Continuous or pulsed	n/a	1.E <sup>-04</sup>
Intertripping	40	Worst Case	200	1.E <sup>-06</sup>	n/a

**Table 3 Teleprotection interface performance.**

Note that Maximum Transmission time is actually the maximum transmission time under noisy conditions at the SNR given for dependability. The times exclude the PLC delay of 2ms. Since the UCC 2021 is integrated, the end to end time should be used.

*For more information regarding the UCC 2021 Power Line Carrier Equipment please contact:*



Calle 8, Edificio PLC, La Urbina, Caracas MI 1073, VENEZUELA  
Tel: +58 212 2436055 / +58 212 2436064 Fax

General info: [info@plc.com.ve](mailto:info@plc.com.ve)  
Sales contact: [sales@plc.com.ve](mailto:sales@plc.com.ve)  
Technical Support: [2021@plc.com.ve](mailto:2021@plc.com.ve)