

# BC-2000 D Multiplexer



**AUDIO AND DATA MULTIPLEXER FOR  
E1/T1/J1 AND ETHERNET LINES**



# BC 2000 D Router and Multiplexer.

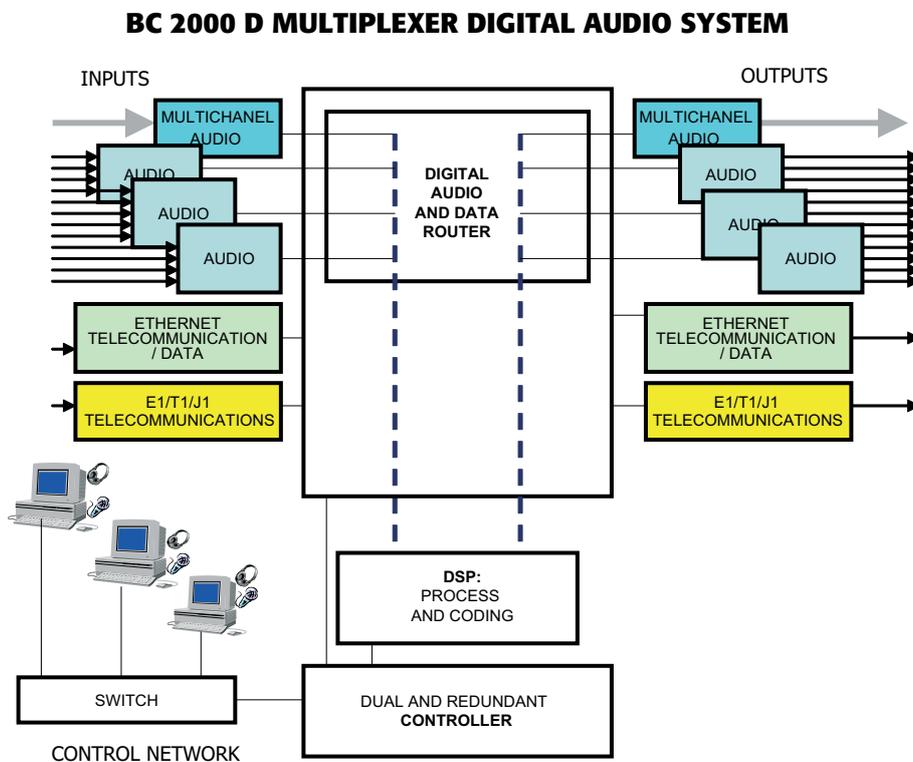
## The second generation



AEQ presented its Ranger multiplexer in the year 2000 at the Sydney Olympic Games, where more than 120 Rangers guaranteed the transmission of commentator audio and the coordination between each of the venues and the Commentary Switching Center. Since those pioneering days we have garnered more than eight years of experience defining needs and lending technical support to the multiplexer networks at major sports and broadcasting events. And we've applied that experience to the design of the BC 2000 D multiplexer.

We've also studied users' ways of managing and supervising systems and the practical problems they encounter, particularly the need to integrate communications links into the audio routing systems in each production center.

## Functional Description.



### HOW IT WORKS

The BC-2000 D Multiplexer is an application of the BC-2000 D router digital audio platform that routes, mixes, processes and distributes audio.

This application enables users to insert and extract digital or analog audio channels in E1/T1/J1 or Ethernet data transmission flows, with added audio encoding / decoding capabilities at different quality levels and in diverse formats.

The link capacities that are not used for audio can be employed for data transport, for which purpose boards are offered with an Ethernet interface.

The audio boards can handle input and output signals, input only or output only, mic and line level analog audio, digital audio in AES/EBU and SPDIF formats, and AES 10 MADI multichannel

digital audio. The communications boards currently included in the system are of the E1/T1/J1 and Ethernet types.

The MADI and E1/T1/J1 boards are provided with electrical and optical interfaces to facilitate connection with the most frequently used equipment and systems.

Between the input and output buses, DSP (Digital Signal Processor) boards are included that can be programmed to encode audio by compressing it so that more channels can be accommodated in a single communications link, or in order to process the signal—for example, for the purpose of summing signals, modifying dynamics, equalizing, detecting silence or graphically displaying the signal level.



The system utilizes controller boards that can be optionally installed in pairs, with dual and redundant functionality. These boards are equipped with an Ethernet interface for connection to the control network using TCP/IP protocol.

From the control computers, system users can not only configure, operate and monitor local and remote devices—they can also set up audio circuits for monitoring or intercom use through the standard multimedia equipment installed in each computer, loudspeakers and microphone, using audio circuits over IP.

### HOW IT'S CONFIGURED

There are installations with only one pair of multiplexers. In other cases, networks connecting dozens of multiplexers route audio between different stations. In both cases, configuration is done by using a software application that communicates via TCP/IP with all the multiplexers in a network.

The local devices and configuration computers must be part of an Ethernet network. To configure the remote devices, you can use the same link, connecting the local network and the remote one through a pair of Ethernet boards, or you can link the networks to create a WAN, or simply by connecting them through the public Internet.

The planning and configuration of a multiplexer network can also be done off line, simply by working with a computer in which the configuration application has been installed. When the computer is subsequently connected to the multiplexer network, you can use the option to download the prepared configuration.

### HOW IT'S CONTROLLED

With the software you can control, monitor and reconfigure any piece of equipment that is connected to the network. You can see the status of all the system boards, change the configuration, check, record and configure alarms, detect silence, monitor audio levels and establish intercom circuits by simply making use of the loudspeakers and microphone connected to the control computers.

Instead of using a computer, each BC-2000 D Multiplexer can be controlled from the front control panel using preconfigured macros.

## Main Characteristics

- The BC 2000 D lets you send several mono or stereo audio channels, with the bandwidth required for each application, to and from several sites over telecommunications lines.
- It provides additional data connections with configurable bit rates.
- It accepts and extracts audio channels with complete flexibility: analog channels at the mic or line level, AES 3 and SPDIF digital channels and AES 10 MAD1 digital channels.
- Because it is based on a router, the system not only transports audio between centers, but also routes it, within each center, to the required place.
- The configuration of all the equipment in a network can be prepared in advance in a computer and downloaded when the system is ready. Additionally, it can be updated ON LINE from any computer connected to the network.
- Control can be local in each multiplexer or centralized for all the devices in the network from a set of computers.
- As a mission-critical system, the BC 2000 D is a solution based on security and redundancy at both the hardware and software levels, with a view to ensuring uninterrupted operation.



# Security

All the audio that is transmitted from a radio network, or the live voice broadcasts generated by the commentators of all the radio and television channels at a major sports event with multiple venues, as well as the coordination of the system, pass through a BC 2000 D Multiplexer system.

All possible precautions should be taken, but the BC 2000 D Multiplexer is designed with multiple software and hardware security, safety and redundancy features, including hot swappable boards that will make the need for any eventualities or urgent repairs, seamless with very little interruptions.

## HARDWARE SECURITY

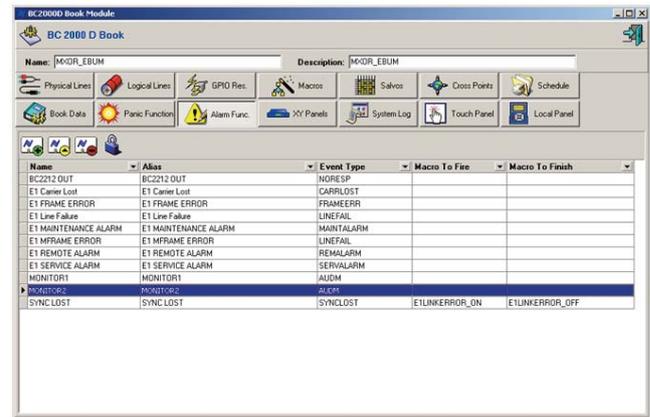
- Selected high-reliability components
- Circuits working well below their maximum allowed levels
- Dual power supply, with hot-swappable modules
- Redundant controller option: If this option is chosen, you will work in a cluster pattern, and the backup controller will take control without interrupting the audio.
- Backup DSP boards that automatically replace a malfunctioning routing or audio processing board.
- Link redundancy option: the system can be configured with a redundant connection so that, if the connection is lost, the backup connection automatically starts up, and when the link comes up again, the previous status is recovered without human intervention.
- Because all boards are hot-swappable, they can be replaced without stopping the system.
- Option of duplicating the rest of the elements: TCP/IP network, client PC network boards, AES-10 MAD1 multichannel links, etc.

## SOFTWARE SECURITY

- Single access profile for each user, with passwords, priorities and masks.
- Multiple security levels: a resource (line, crosspoint, macro, salvo, GPIO, etc.) can only be manipulated by a user with a sufficient authorization level.
- Masks: certain resources can only be seen by authorized users.
- Backup and restore functions for the system and configurations.
- Log file, where all activity is stored in the system, allowing the user actions such as fault cause checks.
- Board status information software.
- After a power outage, the system recovers the state that existed immediately before the incident.
- Protection of the Ethernet link against the depredations of computer hackers.
- Panic function, with fallback to a secure configuration when the user recognizes that he or she has lost control of the system.
- Instant DSP consumption information.

The BC 2000 D Multiplexer can be programmed to execute the following options in the event it needs to inform you of a potential problem:

- Display a message on screen.
- Have a signal appear through a GPO.
- Execute an action defined as a MACRO.
- Call up a user-defined function.



CONFIGURATION OF ALARMS

The following alarm causes are monitored:

- Line failure.
- Absence of carrier wave.
- Frame and multiframe failure.
- Remote alarm.
- System sync failure.
- Failure of the AES synchronization embedded in the audio.
- Communication error.
- Operating failure or lack of response from a board.
- Insertion of a new board.
- Overall power supply failure, or power feed failure in a specific board.
- Alarm planned in time.
- Insufficient audio modulation or simple absence of sound in a line.
- Service alarm.
- Maintenance alarm.
- Alarm composed of several alarms in different devices.

## Planning and Control of BC-2000 D Multiplexer networks

Software has been prepared to monitor and control the system ON LINE with a user-friendly operator interface, protection of critical functions against operator errors, logging of functional problems, etc. An application has also been prepared to let you design and plan the system off line, or adjust the configuration while on the air.

The connection between the software and the controller board of the unit is made through the TCP/IP protocol. This makes it possible to set up a WAN with standard elements (switches, routers, etc.) and organize a control system with hierarchical levels.

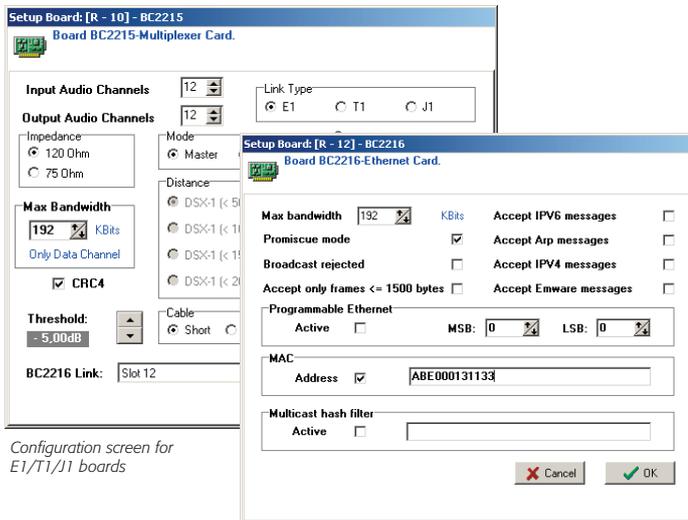
You can also configure and control the equipment when connected through interfaces of the E1/T1/J1 type (without a physical Ethernet connection), enabling the remote devices to be managed and supervised.

# Planning and Control Software

## BC 2000 D SETUP

OFF-LINE and ON-LINE planning application for the BC-2000 D Matrix and Multiplexer systems.

The person responsible for implementing the system can pre-configure the entire system or parts of it. The desired configuration can be saved in a database and subsequently transferred to all the elements when the system is started up. When the pre-programmed configuration is transferred to the system, the software is able to detect installation errors. This significantly reduces the time it takes to setup and test the unit. Since the configuration is stored in each frame, and the software is imported from it, it is always kept updated.

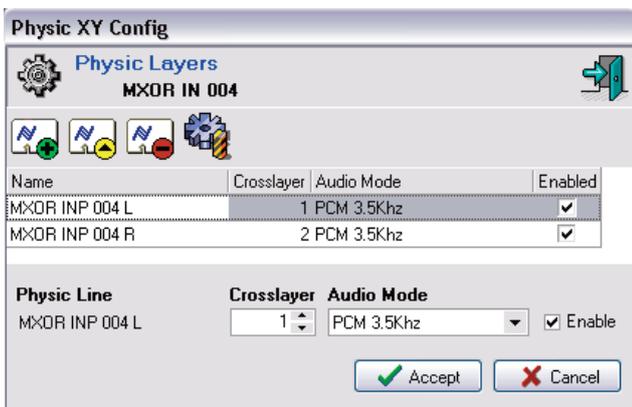


Configuration screen for E1/T1/J1 boards

Configuration screen for Ethernet boards

### Characteristics:

- Configuration of channels with bandwidths of 3.5 kHz, 7.5 kHz, 10 kHz, 15 kHz and 20 kHz of linear or compressed audio with low delay, in mono or stereo.



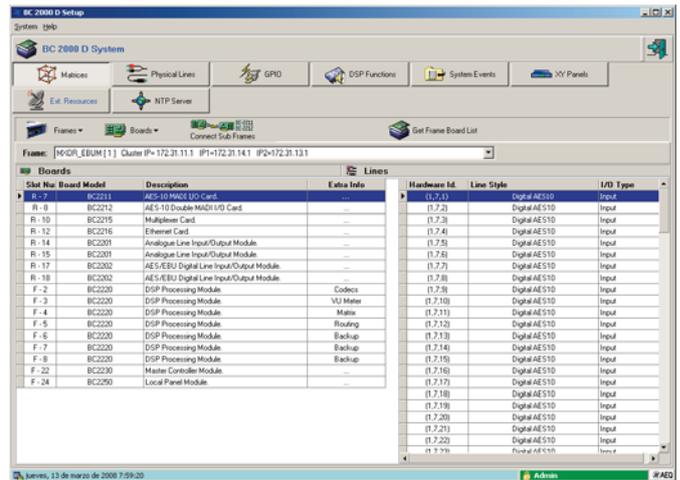
Audio quality configuration screen

- Import / Export to save and retrieve complete configurations.
- Configuration of the audio, data and communications routing matrices: boards for audio inputs and outputs, MAD1 links between racks, communications and data, creation of macros, salvos, etc.

## BC 2000 D RTC

BC-2000 D system real-time control software.

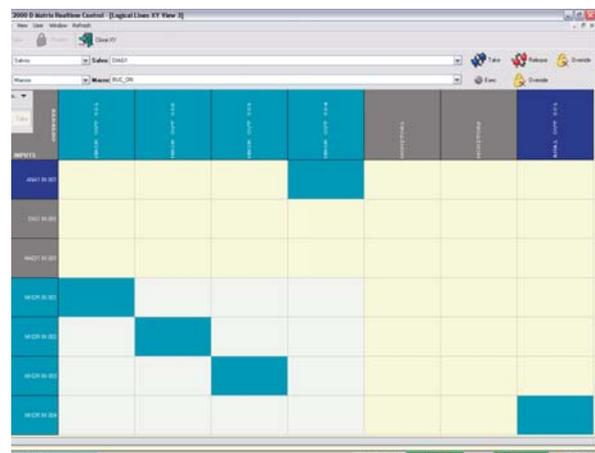
This application performs functions of control, supervision and adjustment of parameters in real time, over all the elements in the system. With this tool, you can control, monitor and reconfigure all the connected devices ON LINE.



Detail of the configuration of all the boards in a frame

### Characteristics:

- Shows the status of all the boards in the system. You can display the current configuration and modify it ON LINE.
- Monitoring and archiving for subsequent assessment of all the system alarms. You can associate specific actions with the alarms.
- Detection of absence of signal, through the definition of a threshold.
- Monitoring the levels and listening to all of the signals in the system.
- Four-wire circuits for communication between different PCs (using standard microphones and headsets), with no need for additional hardware.
- Real-time control of all the matrixes that route audio between inputs and outputs: connections, disconnections, salvos, macros, timed triggers or external events, summing, equalizing, dynamics adjustment, etc.



Audio, data and communications routing screen



# System Components

## PLANNING AND CONTROL ELEMENTS



**BC 2250**  
Front control panel with alphanumeric display, navigator and signaling lights.

**BC 2000 D MPX SETUP**  
OFF-LINE planning and configuration, and ON-LINE reconfiguration software for the BC-2000 D routing systems and multiplexers.

**BC 2000 D MPX RTC**  
BC-2000 D system real-time control software.

## BASIC SYSTEM ELEMENTS

**BC 2000 DF - 2**  
System Central Unit or Frame, 4u x 19", 16 rear slots for installing the input, output and communication modules, two slots for power supplies and two for controllers. 18 frontal slots for processing modules.

**BC 2292**  
200 W power supply module. Self-redundant and autoranging. Powers an entire Frame. For redundancy, two can be installed in each frame.



**BC 2240**  
Master Controller Module with USB, Ethernet and RS 232/422 ports. Includes synchronizing input and general purpose GPI and GPO inputs and outputs. Each Frame needs at least one controller. Two can be installed for redundancy.



**BC 2221**  
High capacity DSP module for processing and routing. Between one and 18 of these modules are installed per Frame, depending on the number of inputs and outputs, communication lines and processing needs.

## INPUT AND OUTPUT MODULES

**BC 2215**  
E1/T1/J1 communications module with RJ45/RJ48 interface for balanced pairs, and with optical interface for SC and multimode fiber.



**BC 2216**  
Ethernet communications module with RJ45 interface, compliant with standard 802.3, configurable in 10 base T / 100 base TX, half or full duplex.



**BC 2201**  
Mono analog line input/output module. This module has four electronically balanced inputs and outputs (two stereo), four GPI and four GPO. RJ 45 connectors.

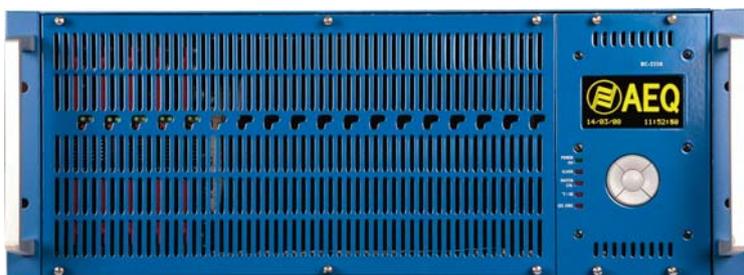
**BC 2202**  
AES/EBU digital input/output module. Four stereophonic inputs and four outputs in AES/EBU format, (individually configurable as SPDIF), transformer isolated. All inputs and outputs have sampling rate converters (SRC). Four GPI and four GPO. RJ 45 connectors.

**BC 2203 M**  
Module for analog inputs balanced by isolation transformer. Four monophonic inputs, Phantom feed, mic / line switching. Four GPI and four GPO. RJ 45 connectors.

**BC 2204**  
Mono analog line input module This module has four electronically balanced inputs (two stereo), four GPI and four GPO. RJ 45 connectors.

**BC 2205**  
Mono analog line output module. This module has four electronically balanced outputs (two stereo), four GPI and four GPO. RJ 45 connectors.

**BC 2205 T**  
Mono analog line output module. Four transformer-balanced outputs (two stereo). Four GPI and four GPO. External XLR connector board.



### BC 2206

AES/EBU digital input module. Four stereophonic inputs in AES/EBU format (individually configurable as SPDIF), transformer isolated. With sampling rate converters (SRC). Four GPI and four GPO. RJ 45 connectors.

### BC 2207

AES/EBU digital output module. Four stereophonic outputs in AES/EBU format, (individually configurable as SPDIF), transformer isolated. Four GPI and four GPO. RJ 45 connectors.

### BC 2211

AES 10 MADI module for linking racks. TX/RX, connection through coaxial cable and optical fiber of 56 or 64 channels with synchronization by wordclock or autosync. BNC and optical connectors. Two modules may be installed for the same link for purposes of redundancy.

### BC 2211 LP

Same function as BC 2211, but with high power optical fiber transceiver for fibers up to and longer than 10 kilometers.

### BC 2212

AES 10 MADI double linking module. Two independent TX/RX connections over coaxial cable and 56- or 64-channel optical fiber for each connection, with wordclock sync and autosync. BNC and optical connectors. Two modules may be installed for the same link for purposes of redundancy.

### BC 2212 LP

Same function as BC 2212, but with high power optical fiber transceiver for fibers up to and longer than 10 kilometers.

## BC 2000 CAB WIRING AND CONNECTOR SYSTEM

There is a complete, versatile system for wiring the matrix. It includes different modules for adapting from RJ 45 to XLR and WAGO connectors, which make assembling the system easier.

Complete wiring systems are prepared, according to the user's needs, including patch panels and distribution frames.



# Technical Characteristics

## E1/T1/J1 COMMUNICATIONS

### E1 Interface

2048 Kbps, 64 kbps for synchronization, 1984 kbps available.  
Selection of AMI or HDB3 line code.  
HDB3 compatible with ITU standard G703.  
Standard framework compatible with ITU G704.  
Line impedance: 120/75 Ohms.

### T1 interface

1544 Kbps, 1 bit per frame is used for frame and multiframe synchronization, alarm monitoring, etc.  
Selection of AMI or B8ZS line code.  
B8ZS compatible with ITU standard G703.  
Standard framework compatible with D4-ATT PUB 4801.  
Selection of superframe in 193S (12 frames per multiframe) or 193 E framing format (24 frames per multiframe).  
Output impedance: 100 Ohms.

### J1 interface

Characteristics similar to those of T1 interface with CRC6 management and yellow alarm according to the Japanese standard.

## ETHERNET COMMUNICATIONS

Ethernet connection with RJ45 interface for balanced pairs.  
Compatible with IEEE standard 802.3.  
10 base T / 100 base T interface.  
Half duplex and full duplex modes.

## AUDIO INPUTS AND OUTPUTS

Radiofrequency protection.  
Transformer-balanced digital inputs/outputs.  
Electronically balanced analog line inputs and outputs.  
Available option: transformer-balanced analog line inputs and outputs.  
Digital inputs/outputs configurable as: AES/EBU (AES 3) and SPDIF, mono and stereo.  
Groupable digital inputs/outputs according to AES 10 (MADI), mono and stereo, 56/64 channels, coaxial, or single mode or multimode optical fiber.

## OTHER CHARACTERISTICS

GPI and GPO (general purpose inputs and outputs for special applications):

- By optocoupler on the input and output boards.
- GPO by relay on the controller boards.

Internal or external synchronization, AES/EBU (AES 11) signals and signals at TTL level (wordclock).

### PROCESSING

Internal sampling rate 48 kHz, 24 bits.  
Internal bus format: 32 bits per sample, floating point.  
Processing functions available (all the operating parameters can be modified by the user in real time):

- Routing and audio mixing with gain adjustment.
- Signal dynamics processing: compressors, limiters, expanders, noise gates.
- Time processing of the signal: Delay and reverberation.
- Generation of the following test signals: tone, white noise and pink noise.
- Four-band parametric equalization in addition to high pass, low pass and bandpass filters.
- Detection of silence or low modulation.
- Audio level measurements: VU meter / peak meter at any input or output.

### AUDIO ENCODING MODES

In all audio modes you can group the channels in stereo pairs.

#### Compressed audio in ADPCM with 16 bits

- AEQ 35: Fs 8 kHz, 32 kbps, bandwidth 3.5 kHz. (up to 62 channels in E1 and 48 in T1/J1).
- G722: Fs 16 kHz, 64 kbps, bandwidth 7.5 kHz. (up to 31 channels in E1 and 24 in T1/J1).
- AEQ LD - EXTEND Fs 32 kHz, 128 kbps, bandwidth 15 kHz. (up to 15 channels in E1 and 12 in T1/J1).

#### Linear audio with 16 bits

- Fs 8 kHz, 128 kbps, bandwidth 3.5 kHz. (up to 15 channels in E1 and 12 in T1/J1).
- Fs 16 kHz, 256 kbps, bandwidth 7.5 kHz. (up to 7 channels in E1 and 6 in T1/J1).
- Fs 24 kHz, 384 kbps, bandwidth 11.5 kHz. (up to 5 channels in E1 and 4 in T1/J1).
- Fs 32 kHz, 512 kbps, bandwidth 15 kHz. (up to 3 channels in E1 and 3 in T1/J1).
- Fs 48 kHz, 768 kbps, bandwidth 20 kHz. (up to 2 channels in E1 and 2 in T1/J1).

### DIMENSIONS AND WEIGHTS, PER FRAME

(WIDTH X HEIGHT X DEPTH; WEIGHT).  
4u x 19" (482.6 x 266.7 x 450.0 mm; from 12 to 22 kg, or 26.4 to 48.4 lbs).



# BC-2000 D Multiplexer



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