488/GPIB BUS EXPANSION AND EXTENSION

4886B
LONGDISTANCE BUS EXTENDER

488.2

DESCRIPTION

The 4886B Bus Extenders allow you to establish an IEEE 488 Bus at the site of your test and measurement application wherever it may be located - whether in another room, at remote test site or around the world.

The 4886B uses twisted shielded pair cable or external modems and the direct dial telephone network to extend the bus to the remote location. The 4886B supports both point-to-point and multiple sites with hardwired cables and external modems. Communication between the sites is serial with the 4886B providing RS-232 and RS-449 (RS-422) compatible interfaces. ICS's proprietary error-detection and correction firmware provides error free data transmission over systems with BER rates as low as 1 part in 10^4.

4886B Bus Extender

Hardwired Operation

A pair of 4886Bs can be hardwired in a back-to-back or multi-drop configuration with a dual twisted-shielded pair cable. The connection uses the 4886B's RS-422 differential drivers and receivers for links up to 1,200 meters. In a back-to-back application, the 4886Bs maintain a continuous communication link between the two bus sites. In a multi-drop application, the link is only made between the local site and the addressed bus extender. Modems can be used to extend the cable length.

Long Distance Operation

When connected to modems with the Hayes 'AT' command set, 4886B Bus Extenders with the -H option can accept commands from the bus controller to dial up the 4886B at the remote site. When the call is completed, the 4886Bs will establish a link between the local and remote sites.

The 4886B-Hs also provide a unique reverse auto-dial capability. When a remote 4886B-H detects a SRQ from a remote device, and if the remote site is not already linked to the local site, the remote 4886B will automatically call the local site, establish a link and pass the SRQ onto the bus controller. The reverse auto dial function uses one primary and two alternate phone numbers stored in a battery backed-up CMOS memory.

- Extends the IEEE 488 Bus beyond the 20 meter limit. *Puts the remote bus anywhere.*
- Operates over hardwired or modem links. *Uses any communications medium.*
- Automatic error detection and data correction. *Provides error free data over noisey links.*
- Dials outbound and SRQ initiated 'phone home' calls. *Lets the local computer communicate with any site and eliminates polling.*
- Transparent to most existing software. *Almost no program changes.*
- RS-232 and RS-422 interfaces standard, MIL-STD-188C-114 interface optional. *Interfaces to commercial and military modems.*
- Metal case provides EMI/RFI protection. *Meets FCC and European RFI/EMI requirements.*

CE *Approved.*

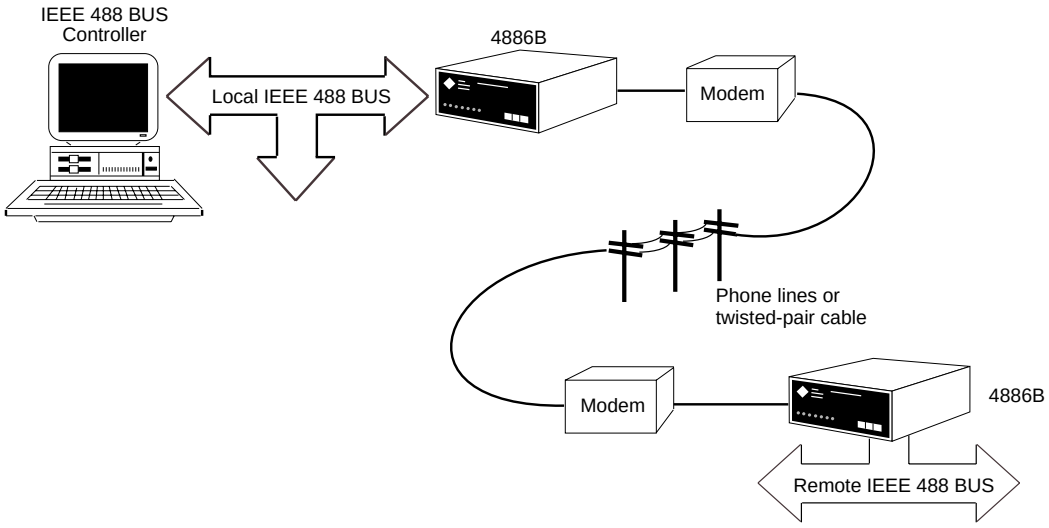

Figure 1 4886B Block Diagram

ICS ELECTRONICS
division of Systems West Inc.
473 Los Coches Street
Milpitas, CA 95035
Phone: **408-263-5500**
Fax: **408-263-5896**
Web: **www.icselect.com**

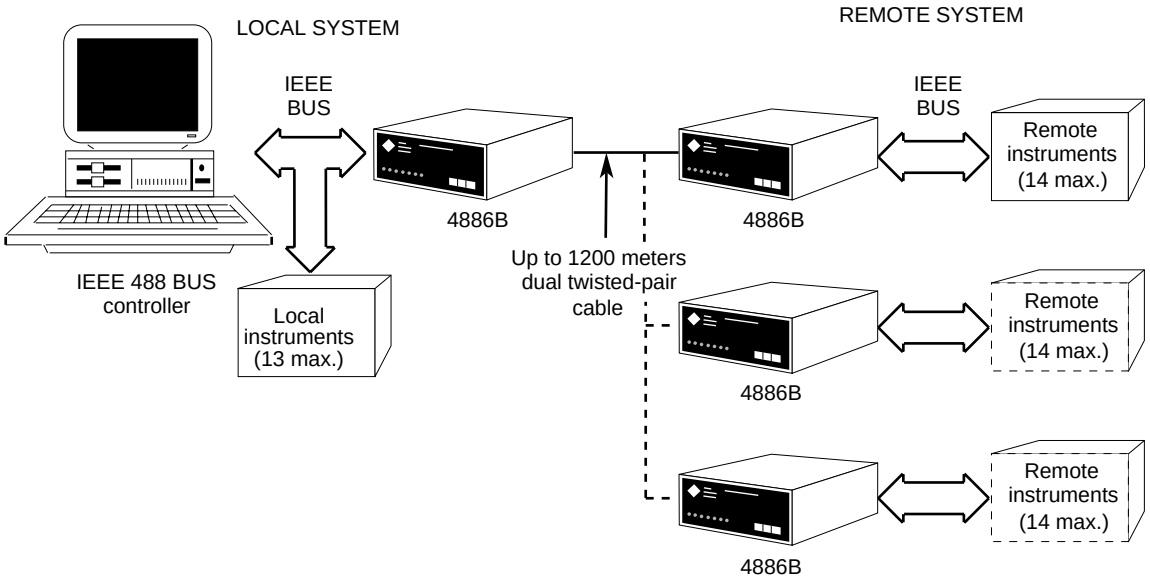

Figure 1 Twisted-pair configuration for bus extensiondistances up to 1,200 meters with optional multidrop sites.

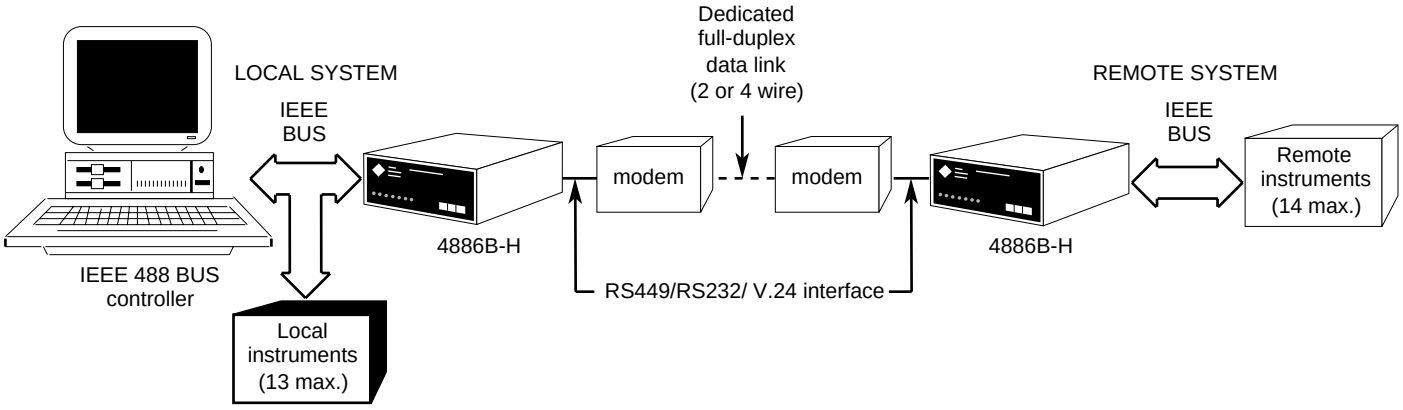

Figure 2 Dialup or dedicated telephone line configuration of rlog distance bus extension

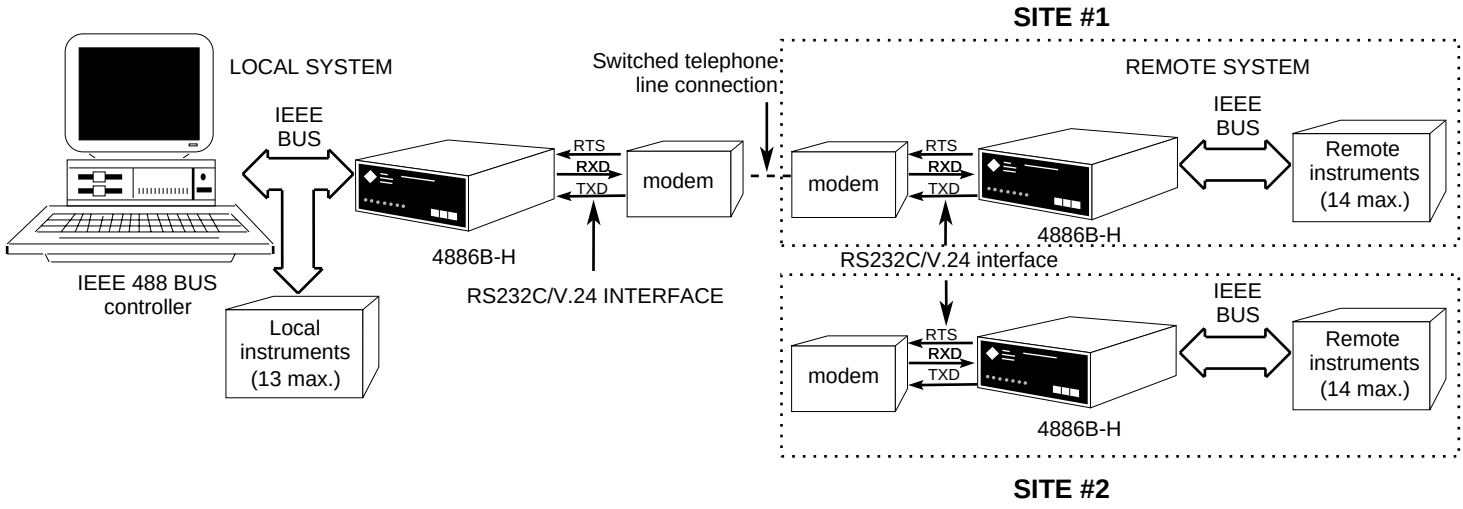

Figure 3 Multidrop telephone line application

Application

The figures in the left hand page show some of the ways that the 4886B Bus Extenders can be used to extend the IEEE 488 Bus to remote locations.

Figure 1 shows that the 4886B can be used either as a point-to-point or as a multi-drop extender using common twisted shielded pair cable or 4 wire telephone cable. Longer distances require the use of dedicated full-duplex modems as shown in Figure 2. The actual link can be metallic cable, fiber, microwave or via satellite links. Figure 3 shows the same concept using the telephone direct dial network (DDN) to establish the link. Model 4886B-H Bus Extenders accept phone numbers from the bus controller and pass dialing instructions onto any 'AT' command set compatible modem to dial a remote location.

Protocol

The 4886Bs use an advanced protocol to communicate with each other over the serial link. The 4886Bs error checking feature ensures error free, bus-to-bus data transmission over circuits with BER rates as high as 1 part in 10^4 over the full baud rate range. When the receiving 4886B detects a transmission error, it requests a retransmission of the faulty message block which is saved in the originating unit's memory. For proper error correction operation, the transmission turn around time must be less than the times listed in Table 1.

Satellite Link Safe

The 4886B's communication protocol also eliminates unnecessary line turn around between message blocks to make them safe for use with satellite or other high turnaround time data links. Geosynchronous satellite communication links have a 0.125 second delay for each up and down path. The 4886B protocol eliminates this delay which could reduce the data transmission rate by over 50 %.

Data Transfer Rates

The 4886B's serial communication protocol uses 5-bit data characters for maximum thruput. The 5-bit code is fine in hardwired applications. However in applications with modems, the character size has to be increased to 8-bits for modem control. The 4886B firmware includes a data compression algorithm that speeds up the 8-bit data thruput by using the unused data bits. The new rate is 1.7 times faster for back-to-back links and 2 times faster for modem links when compared to the same links without data compression. Table 2 shows the original rates and new rates for error free links. Prorate the values for baud rates that are not shown in the Table.

Table 2 4886B Data Rates
(Data rates in bytes/sec)

Baud Rate	Original Rate	Compressed Rate
1200	56	95
9600	449	757
19200	898	1515
38400	1796	3030

HP 37201 Compatibility

The 4886B command set is a super set of the commands used in the HP 37210 series Bus Extenders. 4886Bs can be used to replace the HP 37201 on a pair-by-pair basis but cannot be substituted for a single HP 37201 because of the communication protocol differences. Consult the factory when replacing HP 37201s if dialer output is being used. The complete 4886B command set is listed in Table 3.

Table 1 Link Turn-around Times

Baud Rate	4886B Message Storage Time (sec)	Typical Serial Link	Antiscipated Link Turn-around Time
300	12.00	FSK modem	1.5 sec
1200	3.00	Full-duplex modem	0.86
9600	0.38	Full-duplex modem	0.05
19200	0.19	Hardwire	0.03

Options

The firmware in standard 4886Bs is designed for back-to-back and for multi-drop applications using RS-232 and/or RS-422 drivers and receivers. The following options are available for other applications.

-H Option

Adds autodialing functions to the 4886B firmware and a battery backup CMOS memory to save the dial home phone numbers. The -H option is designed to operate with modems that have internal dialers and which are compatible with the Hayes 'AT' command set. Communication to the modem is over the same RS-232 interface that is used to transfer bus data.

-188 Option

Replaces the 4886B's serial interface with a MIL-STD-188C-114 compatible interface. The -188 option provides both balanced and unbalanced drivers for both kinds of signals. Waveform shaping is optimized for 9600 baud. An invert switch on the interface board inverts the unbalanced signal polarities for compatibility with the low level signals in MIL-STD-188C.

Table 3 4886B Commands

I	Enter Idle Mode
A	Enter Active mode
D	Disconnect a DDN or multi-drop connection
S	Send all data in 4886B's GPIB buffer and generate a SRQ when empty. The SRQ resets the command.
E	Inhibits clearing the buffers when if the talk address is repeated.
F	Clears buffers on a new talk address.
V	Inhibits addition of UNT after a serial poll.
U	Reversed V and adds a UNT after a serial poll.
R	Enables clearing local TX buffer after loss of remote data id SRQs are enabled.
Q	Reversed R command.
N	Starts phone number
T	Phone number terminator
M	Starts multi-drop address
X	Redial command
B	Stores phone number
C	Reads phone number
W	Queries remote extenders address switch.

IEEE 488 Bus Interface

The 4886B's 488 Bus interface meets IEEE STD 488.1-1987 and has the following capabilities for the Local Bus Extender::
SH1, AH1, T7, L4, SR1, PP0, DC0, RL0, DT0, C0 and E1 drivers.
Remote Bus Extender:
C1-C4 and C9

Address Capability
Primary addresses 0-30

SRQ Generation
SRQs are generated if the local unit is not a talker, if SRQs are enabled and if an Enabled Status Register bit occurs or if an SRQ is received from the remote bus.

Serial Poll Response
the 4886B provides the following Serial Poll Response :

DIO Bit	Meaning
1	Data Carrier Detect line input
2	Data Set Ready line input
3*	Cannot complete connection
4*	Connection complete
5*	Cannot send to remote 4886B
6	Remote SRQ detected
7	RSV bit
8*	Local transmit buffer empty

* = factory enabled Status Bits

Parallel Poll Response
The Parallel Poll Response from the remote bus is delayed by the transmission and turnaround times of the serial data path between the two bus extenders plus a 20 millisecond delay in the remote extender. The remote bus extender stores the parallel poll response and outputs it in response to the next parallel poll.

Auto-Dialer Capability
Dials upon command or when remote SRQ detected. Stores three 32 digit phone numbers.

Transparency

Except for timing restrictions on the parallel poll response message, the entire set of IEEE 488.1 and 488.2 bus commands can be extended from the local bus to the remote bus.

Serial Interface

RS-449 Interface with RS-422 and RS-232 (CCITT V.24) signals. Operates with asynchronous and synchronous full-duplex modems. Uses 1x or 16x clocks.

RS-232 interface is a DTE type interface with BA, BB, CA, CB, CC, CF and CD signals.

RS-422 interface provides CS, DM, RD, RR, RS, RT, SD, ST, TR and TT as balanced lines. TM and TC are single ended inputs.

Baud Rates 110 to 38,4000
Character Format 5-8 data bits, 1-2 stop bits, even/odd/none parity

Front Panel Indicators

PWR Indicates power on
RDY Serial interface is connected. Blinks when remote unit's buffer is full or message is being retransmitted.
MTA Unit is addressed to talk.
MLA Unit is addressed to listen
LINK Unit is connected to a remote unit
ERROR Blinks when data link error are being retransmitted.
DIALING On when unit is dialing a remote 4886B. Blinks while waiting for a call to be answered.

Controls

POWER Applies power to the unit
RESET Clears units internal logic
DTR OFF Disconnects dial-up link
Address-Rear panel rocker switch selects GPIB bus, multi-drop or remote site address.
Serial Control-Rear panel rocker switch that sets baud rate, character configuration and clock sources.

Physical

Size W x H x D
8.6 x 3.4 x 11.4 inches
(21.9 x 8.8 x 29.0 cm)

Weight 6 lbs (2.7 kg)

Temperature
0°C to +50°C Operating
-20°C to +70°C Storage

Humidity 0-90% RH no condensation

Construction All metal case

Connectors
IEEE bus-STD 24 pin with metric lock studs
RS-449 Serial I/O - Cinch DC-37P with lock studs

Power 110/115/200/230 Vac±10%, 48-62 Hz, 35 Watts max.

Included Accessories

Instruction Manual

ORDERING INFORMATION

	Part Number
IEEE 488 Bus Extender, 115 Vac power	4886B
IEEE 488 Bus Extender with -H autodial firmware, 115 Vac power	4886B-H
Power options - add -J1 for 100 Vac, -J2 for 200 Vac and -E for 230 Vac settings (no charge)	-J1/-J2/-E
RS-232 to Modem cable, 2 meters long	112300
RS-449 cable for back-to-back operation. 'L' is length in meters from 001 to 999.	112303-L