# LONG DISTANCE BUS EXTENDERS

# Description

ICS's Model 4889 Series Bus Extenders dramatically improve IEEE 488 bus use by providing GPIB bus extension up to 25 km at data rates of 300 Kbytes per second. Through the use of ICS's patented protocol, the 4889's bus transfer rate remains unchanged as the bus extension distance increases - even for distances out to 25 km. This enables long distance, high speed data transfer from computer-to-computer or to remote devices over the GPIB bus.



The 4889 Series Bus Extenders are transparent to all GPIB commands including Parallel Poll and Pass Control. The 4889 Series include unique features such as parallel poll of link status, automatic freeing of local bus handshake in event of a link failure and internal data buffers to maximize bus handshake rates.

The 4889 Bus Extenders are offered in three versions with different fiberoptics and bus extension capabilities. The 4889A uses 820 nm wavelength optical signals and provides up to 2,000 meters of bus externsion. The 4889B uses 1320 nm wavelength optical signals and provides up to 5,000 meters of bus extension. The 4889L provides up to 25 km of bus extension using single-mode fiberoptic cables. All three Bus Extenders have isolated tranceivers that can extend the bus up to 500 meters using dual coaxial cable.

# Hostile Environment, Noise Immunity and Data Security

In addition to greatly increased distance, the 4889's fiberoptic link capability offers a special advantages to industrial and security conscious users by providing electrical isolation between local and remote sites. In electrically hostile environments such isolation eliminates the possibility of EMI/RFI interference, precluding disturbance of the transmitted data. The same

> properties that make the links immune to outside interference also prevent signal radiation or detection through ordinary means. The fiberoptic links also eliminate equipment damage from lightning strikes along the fiberoptic links.

# Applications

You can use the 4889 Bus Extenders in a number of installation configurations, including site-to-site, in a star configuration (to many sites) or in tandem (cascading site to site).



Figure 1 - Long Distance IEEE 488/GPIB data link provides secure, error free data even in severe environments.

# 4889A 4889B 4889L HIGH SPEED LONG DISTANCE IEEE 488 BUS EXTENDERS

- Data transfer rates over 300K bytes/sec.
  Highest speed fiberoptic bus extenders!
- Extends the bus to 2,000, 5,000 or over 25 km using fiberoptic cable or to 500 meters with coaxial cable. *Wide selection of fiber lengths.*
- Proprietary transmission algorithm maintains the specified data transfer rate regardless of cable length. *No loss of data transfer speed with distance.*
- Fiberoptic link provides error free, secure data that is immune to EMI/RFI interference. *Secure data always.*
- Completely transparent to all 488 Bus commands including Parallel Poll and Pass Control. *No special programming needed.*
- Responds to a Parallel Poll with link status. Only bus extenders able to report link status.
- Free handshake function. *Prevents bus hang-up in case of remote bus failure.*





Web: www.icselect.com

# APPLICATIONS

## Applications

The 4889 Series Bus Extenders can be used in a number of configurations including site-to-site links, in star configurations to connect multiple remote sites to a central site, or in parallel to form high data rate links. The site-tosite link is shown on the front page. Figures 2 and 3 show the star and parallel configurations.



Figure 2 4889s used in parallel to form a high data link



#### Figure 3 4889s in a Star Connection to drive multiple remote sites

## **Data Transfer Rate**

The 4889's patented communications protocol provides very high speed bus extension regardless of the extension distance between extenders. Figure 4 shows the handshake rates of some fiber-opticbus extenders vs distance. Note that other bus extenders only cover short distances because their handshake rates drop as distances increase. While these extenders have the power for longer distances, their usefulness is greatly diminished.

#### Link Status

The 4889 can be set so it provides the link status as a bit in the parallel poll response word. This capability lets the controller monitor the link status and determine when to reconnect to the remote bus in the event the link was truncated

#### **Bus Truncation Function**

Recognizing that everything does not always go smoothly with a remote site, the 4889 Bus Extenders have the ability to free the local bus in the event of a link



failure. This includes a remote power failure or a cable break. In either case, the local 4889 holds the bus until the controller times out. Then, if the controller's issues a IFC in its recovery routine, the local 4889 goes into a free handshake mode. When the link is restored, another IFC will cause the 4889 to resume sending data to the remote bus. Older extenders without truncation will hold the local bus until manually turned off. The 4889 can also be set to automatically free the local bus when the kink is lost or to never free the local bus.

#### Parallel Poll Response

The 4889 requires additional time to respond to a parallel poll due to the time it takes for the parallel poll to get to the remote site and back to the local controller. The design of the 4889 minimizes the delays so that they are less that the parallel poll delay built into most GPIB controllers. Table 4 shows that 4889's parallel poll and SRQ delay times. For Bus Controllers with shorter parallel poll delay times, the local 4889 saves the last parallel poll response and outputs it

> when parallel polled. The arrival of the current response updates the stored value. To always be sure of reading the correct value from the remote devices, the 4889 should be parallel polled twice.



## **Transmission Medium**

The 4889 Bus Extenders use dual fibers or dual coaxial cables to extend the GPIB bus. Fiberoptic cable is recommended for outdoor and long distance applications. Avoid metalic strength members in lightning prone areas.

**Coaxial Cable** - Each 4889 Bus Extender includes a coax driver qand receiver which work with dual 75 ohm coaxial cables to extend the bus up to 500 meters where electrical isol; ation is not required. Data rate is the same as with the fiberoptic cables.

**Fiberoptic Cable** - The 4889 Bus Extenders provide a choice of optical wavelenghts, optical connectors and bus extension distances. Although the 4889 Bus Extenders work with a wide variety of fibers, careful selection of fibers will yield the best results and longest extension distances.

#### 4889A

The 4889A uses SMA or optional ST connectors that accept a variety of multimode fiber sizes. Table 1 shows bus extension distance for 62.5/125 or 50/ 125 fiber cables. Maximum extension distance is 7 km.

#### Table 14889A Fiber Cable Lengths.

Fiber	Typical Fiber	Allowable
Diameter	Attenuation	Cable Length
(µm)	(dB/km)	(km)
62.5/125	3.5	2.5 to 3.4
50/125	3.0	1.7 to 2.7

#### 4889B

The 4889B Bus Extender uses ST fiberoptic connectors and 1320 nm optical wavelength signals from a LED transmitter to drive multimode cable. Table 2 shows bus extension distance for 62.5/ 125 or 50/125 fiber cables. Maximum extension distance is 7 km.

Table 2	4889B	Fiber	Cable	Lengths
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Fiber	Typical Fiber	Allowable
Diameter	Attenuation	Cable Length
(µm)	(dB/km)	(km)
62.5/125	1.2	9.16
50/125	1.5	5.3

#### 4889L

The 4889L Bus Extender uses FC/PC fiberoptic connectors and 1320 nm optical wavelength signals from a Laser transmitter to drive singlemode cable. Cable distances are shown in Table 3 for various fiber attenuations and numbers of splices. Fiber is  $8.3/125 \,\mu$ m diameter. Typical splice attenuation varies from 0.25 to 0.5 dB per splice. Maximum cable length is 27 km.

Table 3	4889L	Fiber	Cable	Lengths
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Typical Fiber	Splices	Allowable
Attenuation	at	Cable Length
(dB/km)	0.4 dB	(km)
1.0	.2	18.2
1.0	5	17
0.5	5	34
0.5	15	26

## SPECIFICATIONS

## **Link Specifications**

Each 4889 Bus Extender has coaxial and fiberoptic link capability. All 4889 links are full-duplex links with transmit and receive connectors.

#### **Coaxial Link**

Connectors:	BNC jacks
Distance	Up to 500 feet with low
	capacitance coaxial cable
Cable:	
Туре	Belden 9248 or
	equivalent
Conductor	18 gauge solid, 24.6 $\Omega$ /
	km
Shield	Duo-foil plus braid,
	$17.1 \Omega/km$ , $100\%$
	coverage
Impedance	75 Ω
Capacitance	56.8 pF/m
Attenuation	$4.9  \mathrm{dB} / 100  \mathrm{m}  (50  \mathrm{MHz})$

#### **4889A Fiberoptic Link**

Connectors:	SMA standard
	ST optional
Wavelength:	820 nm
Output Pwr:	-15 dBm min into
1	62.5/125 μm fiber
Receiver:	-27 dBm min,
	-15 dBm max
Pwr Adj:	4 steps
Distance	> 2 km with appropriate
	fiber. 7 km max.

#### 4889B Fiberoptic Link

Connectors:	ST
Wavelength:	1320 nm
Output Pwr:	-15 dBm min into
	62.5/125 μm fiber
Receiver:	-27 dBm min,
	- 15 dBm max
Pwr Adj:	4 steps to -25 dB
Distance	> 5 km with appropriate
	fiber. 7 km max.

#### 4889L Fiberoptic Link

Connectors:	FC/PC
Wavelength:	1320 nm
Output Pwr:	-6 dBm min
Receiver:	-27 dBm min,
	- 15 dBm max
Pwr Adj:	None
Distance	> 25 km with appropri-
	ate fiber. 27 km max.

#### Table 4 4889 Response Times vs Cable Length

Coaxial cable length, meters Service Request (SRQ) delay, μs Parallel Poll response time, μs	20 8 20	100 8.5 21	500 10 24			
Fiber cable length, meters	20	500	1000	2000	5000	25000
Service Request (SRQ) delay, μs	8	11	13	18	33	133
Parallel Poll response time, μs	20	25	30	41	74	274

#### **IEEE 488 Bus Interface Functions**

The local 4889 transparently passes all bus commands and data to the remote 4889 (responses from the remote devices will be delayed slightly) and has these bus capabilities: SH1, AH1, T0, TE0, L0, LE0, SR0, PP2, RL0, DC0, DT0, C0, E1/E2.

#### **Parallel Poll Response:**

- Own response logic '1'= linked Remote response - stored and outputted during next parallel poll
- Data Transfer Rate: >300 Kbytes/sec. regardless of cable distance
- Transfer Delay (SRQ): 8µs min. to 133 μs max. at 25 km.
- Parallel Poll Response Delay: 20µs min., to 274 µs max. at 25 km.

#### HP CS/80 Compatibility

Operates with Hewlett-Packard CS/80 computer peripherals on the local or remote bus.

#### **Bus Truncation**

When enabled, the local 4889 will free the local bus either automatically or upon receipt of an IFC message when the link is lost. When the link is restored, data transmission to the remote site will resume starting with the next IFC message.

The 4889 includ indicators for extender's statu	es a full complement of visual display of the s and link performance.
PWR LINK	Lights when ac is on Lights when remote-to- local is established and
DATA I/O	operational Blinks when data is passing through the extender or across the

**Front-Panel Indicators** 

#### link SYSTEM Lights when 4889 detects presence of two ERROR bus controllers Flashes when a serial SERIAL ERROR transmission error is detected FREE H/S Lights when local 4889 has truncated the link and freed the local-bus handshake TEST Lights when 4889 is in test mode and unable to send data

#### **Rear-Panel Controls**

E2	Sets bus drivers for
	tristate/open-collector
	operation
LOCK	Synchronizes hand-
	shakes on local and re-
	mote buses
FREE	Lets 4889 automatically
	free the local bus if link
	fails
TRUNC	Lets 4889 free the local
	bus on IFC if no link
PPR 1, 2, 4	Selects Parallel Poll re-
	sponse bit
LPE	Enables Parallel Poll
	response
COAX	Selects coaxial/
	fiberoptic link
RLB	Enables remote loop-
	back test

## **Front-Panel Controls**

**POWER** Turns as power on / off RESET Resets internal 4889 logic

#### Physical

Connectors:	
IEEE 488 Bus in	nterface:
Amphenol	57-20240, metric lock
studs	
Coaxial cable I	/O:
Isolated BN	C jacks
Optical transm	itter and receiver:
See Link Spec	cifications
Dimensions: V	WxHxD
8.6 x 3.47 x 1	1.4 inches
(21.9 x 8.8 x	29.0 cm)
Weight	·
8 lbs. (3.6 kg	<u>r</u> .)
Temperature	, .
Operating	0° to +50° C
Storage	-20° C to + 70° C
Humidity	
0-90% RH w	vithout condensation
Shock/Vibratio	on
Normal han	dling only
	0 ,

#### Power

90-130/180-260Vac, 48-62 Hz, 28 Watts, maximum. Internal switch selects 115/230 Vac, Jumper selects 100/115 or 200/230 Vac

## Approvals/Certificates

EMI/RFI	Approved for Class A, Part
((	15 of FCC Docket 20780,
עכ	EEC Standards EN55022
	and 50082-2
UL/IEC	Designed for UL 1950, and
	IEC 950 Compliance

Part Number

## **Ordering Guide**

#### 4889A Bus Extender, with coaxial and 820 nm fiber-optic driver and SMA connectors 4889A 4889A Bus Extender, with coaxial and 820 nm fiber-optic driver and ST connectors 4889 A-8(114027) 4889B Bus Extender, with coaxial and 1320 nm fiber-optic driver and ST connectors 4889B 4889L 4889L Bus Extender, with coaxial and 1320 nm fiber-optic laser driver and FC/PC connectors Power: 115 Vac supplied standard; for 100 Vac, specify Option Suffix-J1; for 200 Vac, -J2; for 230 Vac -E No charge Dual coaxial cable assembly, BNC connectors, L=1 to 500 meters. 113719-L Dual fiber cable assembly, 62.5/125 fiber, L = 1 to 999 m, SMA connectors = P/N 113292-L, ST connectors = 114049-L

Preliminary data subject to change without notice

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