Global Caché
GC-IRE
IR Extender

Overview. The GC-IRE IR Extender is a new concept in automated controls that allows IR devices, such as remote controllers, to act as digital input devices in a networked environment. The GC-IRE digitizes IR inputs from a Global Caché, Xantech, or SpeakerCraft IR receiver or distribution block. By converting this IR information to serial ASCII text, IR can now be considered a new input method for digitally controlled installations.

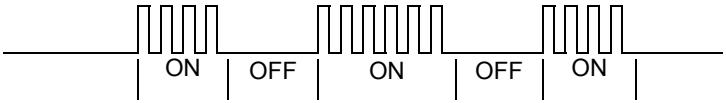
The GC-IRE has two interfaces, a 3.5mm stereo jack for IR input and a serial RS232 male DB9 connector for ASCII text output. The serial connection provides both power (no external power supply is required) and two-way communication for GC-IRE configuration and IR output. Additionally, an IR noise measurement mode is available to assist in proper placement of IR receivers to minimize background IR interference. The GC-IRE samples IR input including background noise and modulation frequency. It then attempts to filter out incomplete IR commands, background noise, and incorrect IR patterns before transmitting good IR commands as serial ASCII text.

Getting Started. A simple method to become familiar with the GC-IRE is to connect it to the PC's RS232 serial port and send commands using Windows Hyper Terminal. Hyper Terminal can be found under Programs/Accessories/Communications in the PC's Start menu. After selecting Hyper Terminal, enter a name such as, PC_9600 and click OK. When prompted with "Connect using," select COM1, not TCP/IP. In the next window; for "bits per second" select 9600; for "data bits" select 8; for "parity" select none; for "stop bits" select 1; and for "flow control" select none. Now click OK to complete your Hyper Terminal setup.

Plug the GC-IRE into the PC's COM1 serial port. Since power is supplied by the RTS line (pin 7), flow control (handshaking) must be disabled for proper operation. At power up, the ACT indicator will blink once and then remain on. This indicator will also blink when receiving IR signals, to indicate IR activity. Type gv↵ in the Hyper Terminal window to obtain the version number of the GC-IRE.

The GC-IRE is ready to receive IR information. Plug in a Global Caché IR receiver (GC-RF1 or GC-RG1) or a GC-CXG from a Xantech and SpeakerCraft IR installation to the "IR IN" 3.5mm stereo jack. As IR is received the ACT indicator will blink and the IR digitized output will be sent to the open Hyper Terminal window.

IR Encoding and Transmission. The GC-IRE transmits IR signals in real time as comma delimited ASCII text terminated by a carriage return (↵). Other terminators may be used, see command set. An IR signal is a sequence of ON and OFF states modulated with a carrier frequency (f) during the ON state. Most IR remote control devices operate at frequencies near 40KHz with some devices operating up to 500KHz. The ON and OFF timing is measured in periods (τ) of the carrier frequency, where $\tau = 1/f$. For example, an ON state of 24 represents 600µS for a carrier frequency of 40KHz, (600µS = 24 / 40,000Hz).



The GC-IRE employs a compression scheme to reduce serial data for better performance. Uncompressed IR signals are represented in the following manner as shown below.

GC-IRE,<frequency>,<ON1>,<OFF1>,<ON2>,<OFF2>,…,<ONn>,<OFFn>↵

where;

<frequency> is	/32000/33000/…/500000/	hertz
<ONx> is	/2/3/…/65535/	carrier frequency periods
<OFFx> is	/2/3/…/65535/	carrier frequency periods
↵ is	0x0D Hex	ASCII carriage return

The following is an uncompressed ASCII text string representing a typical IR remote control signal. Alternating ON/OFF pairs are highlighted to improve readability.

GC-IRE,55000,**22,340**,24,156**,24,158**,23,92,**23,157**,23,157,**23,92**,23,156,**23,156**,

23,157,**23,157**,23,156,**23,310**,23,311,**23,156**,24,156,**23,157**,23,1100↵

The IR signal has a 55000Hz (55KHz) carrier frequency, with its first ON state of 22 periods or 400µsec. The following OFF state is 340 periods or 6.182mS in duration. The final 1100 OFF actually may be longer, but after 20mS of inactivity the GC-IRE considers the IR signal to be finished. The 20mS value can be changed to suit special installation needs, see IRend commands below. Typically, 20mS is sufficient time between IR commands to avoid misinterpreting back-to-back commands as one long command. Most remote controls repeatedly send IR commands when the button is held down inserting a pause between each command. The GC-IRE always encodes commands as separate commands if this pause is greater than the IRend setting. Otherwise, commands are concatenated into one long command. The GC-IRE adds a final OFF pulse equal to the IRend setting at the end of each IR command. The last OFF is calculated as IRend * f, where IRend is in seconds.

Some IR remote controllers will send continuous back-to-back IR commands for volume control and fast-forwarding of media. In rare circumstances, a continuous IR command may overflow the GC-IRE's internal buffer. To indicate an overflow, the current serial IR transmission is halted and truncated with an ASCII X. All IR activity must stop for IRend seconds before a new IR signal will be transmitted.

To further reduce the likelihood of buffer overflow, all IR serial data is compressed. The GC-IRE takes advantage of the fact that many ON/OFF pairs are repeated several times within an IR command. By representing a repeated ON/OFF pair with a single upper-case letter A, B, C, or D, IR serial data can be reduced up to one third of its original size. The compression process works by assigning an A to represent the first pair in a new IR signal, B to the next different pair, and so on. Using compression, the first occurrence of an ON/OFF pair is transmitted as before, with all subsequent repeats of that pair represented by its assigned single letter. To aid compression, ON/OFF values are considered equivalent if they are within three

counts of each other, minimizing the effects of noise and round-off errors. The previous IR command is compressed as shown below. Letters A thru D are assigned as follows: A = ,22,340; B = ,24,156; C = ,23,92; and D = ,23,310. Remembering that ON/OFF values can be within three counts of the assigned valued above, the original IR command will compress to the following.

GC-IRE,55000,**22,340**,24,156**B**,23,92**B**B**C**B**B**B**B**B,**23,310**D**B**B**,23,1100↵

Since the first pair 22,340 never repeats, the letter A is not used. Additionally, if the last pair 23,1100 had repeated, it would be sent uncompressed since all four letters are assigned to other pair values. Finally the letters are sent without comma delimiters reducing the original signal from 138 to just 61 characters.

IR Noise Filtering. The GC-IRE contains filtering to improve performance by removing false IR signals occurring from direct sunlight and fluorescent lights. Incomplete IR signals are also caused by remote controllers operated from too great a distance, partially blocked, pointed poorly, or in need of fresh batteries. The GC-IRE filtering is not intended to correct a corrupted IR signal, but to prevent it from being transmitted out as serial data. However, when an IR signal becomes corrupted during its transmission, the GC-IRE transmission is halted and truncated with an ASCII Z.

Noise Measurement. Included in the GC-IRE is the ability to measure background IR noise. By enabling the noise meter (ny↵) through Hyper Terminal, continuous data values (from 0 to 100%) are transmitted serially indicating the amount IR signals received within the sample period. This is helpful when placing an IR receiver near fluorescent lights or plasma TVs. By optimizing IR receiver placement, unwanted noise can be minimized or avoided completely. With placement complete, the noise meter is disabled (ny↵) and IR remote control commands can be sent.

String Terminators. The terminators used for data transmitted from the GC-IRE may be changed to better suit the software environment in which the GC-IRE is being used. For example, it may be more effective to use a carriage return, line feed for a UNIX/Linux system, and a NULL for a system employing Flash or other software requiring NULL terminated strings.

Command Summary

Cmds	Definition	Response	Stored	Action
gv↵	get version	ver,x.x.x ⇐	-	where x is a number
id↵	identity of device	device,GC-IRE⇐	-	-
gs↵	get state	IRend,<X>msec⇐	-	where <X> is
|20|35|50|100|				

GC-IRE Settings

Cmds	Definition	Response	Stored	Action
tc↵	CR terminator	-	yes	send 0x0D hex
tl↵	CR LF terminator	-	yes	send 0x0D 0x0A hex
tn↵	NULL terminator	-	yes	send 0x00 hex
Cmds	**Definition**	**Response**	**Stored**	**Action**
e1↵	change IR end	IRend=20msec⇐	yes	sets IR end to 20msec

e2↵	change IR end	IRend=35msec⇐	yes	sets IR end to 35msec
e3↵	change IR end	IRend=50msec⇐	yes	sets IR end to 50msec
e4↵	change IR end	IRend=100msec⇐	yes	sets IR end to 100msec
ny↵	noise meter yes	-	no	enable noise meter
nn↵	noise meter no	-	no	disable noise meter

Special Responses

Cmds	Definition	Response	Stored	Action
-	-	unknowncommand⇐	-	received invalid cmd
-	-	X⇐	-	indicates buffer overflow
-	-	Z⇐	-	invalid IR signal

Specifications

Serial Interface

Encoding	Comma delimited ASCII text ending with a terminator
Connector	Female DB-9, DTE format RTS, pin 7 – used for power Gnd, pin 5 – signal and power ground TxD, pin 3 – transmit data to the GC-IRE RxD, pin 2 – received data from the GC-IRE
Baud rate	9600
Other	No parity, one stop bit
Flow Control	none
Power	Supplied by RTS (pin 7), must be 7 to 25 volts @ 5mA

IR Sensor interface

Connector type	3.5mm stereo jack
IR frequency range	30 to 500KHz
Power supplied	7 to 25 volts @ 2mA

Global Caché, Inc.
160 East California Street, PO Box 1659
Jacksonville, Oregon 97530
Phone (541) 899-4800
Fax (541) 899-4808
www.globalcache.com
Support: support@globalcache.com
Sales: sales@globalcache.com
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