GC-IRE API Specification
Version 1.0

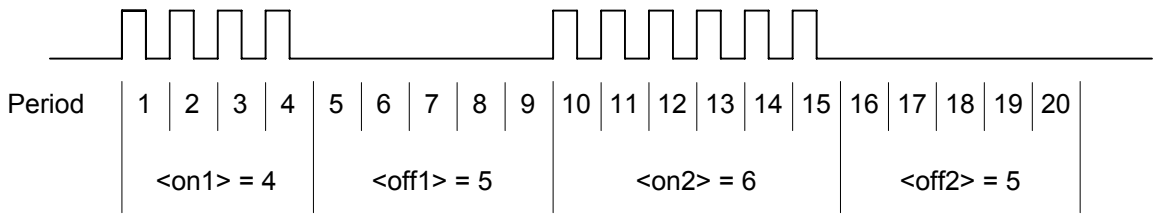
1. The GC-IRE

The Global Caché GC-IRE extends infrared (IR) capability by digitizing IR signals for learning IR commands, initiating actions, and recording IR signals for playback to other locations in the networked home. The unique GC-IRE not only works over a wide frequency range, from 32 KHz to 500 KHz, it also includes the carrier frequency providing a complete IR representation. As a result, the GC-IRE works with a broad range of IR remote controllers. The GC-IRE consists of a small IR sensor and a converter for transmitting IR information to RS232 serial devices. Other IR input devices, such as Xantech products, can be plugged into the GC-IRE bypassing the internal IR sensor.

2. IR Signal Encoding

The GC-IRE transmits IR signals in real time as comma delimited ASCII text strings terminated by one of many terminator characters (⇐) which is discussed later. The ASCII structure is similar to the GC-100 IR output commands to simplify IR recording and playback.

An IR signal is a sequence of on and off states modulated with a carrier frequency during the on state (see figure below). Most IR remote control devices operate at frequencies near 40 KHz with newer devices operating up to 500 KHz. *On* and *off* states are measured in periods of the carrier frequency ($\tau = 1/f$). For example, an on state of 24 represents 600µs for a carrier frequency of 40 KHz (600 µs = 24 / 40,000Hz).



The IR sequence begins with GC-IRE to identify the data. See below.

Sent from the GC-IRE:

GC-IRE,<frequency>,<on1>,<off1>,<on2>,<off2>,…,<onN>,<offN>⇐

where;

<frequency> is	/32000/33000/…/500000/	(in hertz)
<on1> is	/4/5/…/65635/	(carrier frequency periods)
<off1> is	/4/5/…/65635/	(carrier frequency periods)
⇐ is	0Dh, 0Dh 0Ah, 00h	terminator character(s)

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The following is an ASCII text string representing a typical IR remote control signal:

GC-IRE,55000,22,340,24,156,23,92,23,157,23,157,23,92,23,156,23,156,23,157,23,157,23,156,
23,157,23,157,23,156,24,156,23,157,23,157,23,1375⇐

The string above is interpreted as a signal with a 55 KHz carrier frequency. The first *on* state is 22 periods at the carrier frequency or 400µsec. The following *off* state is 340 periods or 6.182 ms in duration. The final 1375 *off* state may actually be longer, but is cut off by the GC-IRE after 25 ms. This is long enough to distinguish between two separate signals rather than possibly misinterpreting them as one long signal that would fail to perform their intended functions during playback. Most remote controllers repeatedly send IR commands when the button is held down. A pause is usually inserted between each IR command sequence. Sometimes repeated commands differ from the first command. The GC-IRE encodes repeated commands as separate commands if the pause between the commands is less than 20ms. Otherwise, repeated commands are sent as one long command. The last *off* state is calculated as .025ms * f, where f is the carrier frequency in hertz. This guarantees 25ms spacing between IR signals when played back as output commands.

The format above also allows simultaneous transmission of the ASCII text string during IR input, thus eliminating undesirable delays in IR commands.

3. IR Signal Compression

Some IR remote controllers send continuous signals without pausing between commands, for example when holding down the volume control. For low baud rates, this may create a condition where the GC-IRE is unable to transmit serial data fast enough to keep the IR commands from overflowing the internal serial buffer. To avoid this GC-IRE employs a compression mode to reduce the serial data to as much as one third its original size. Compression is enabled by command *cy* (compression yes) and disabled by command *cn* (compression no). Whether or not compression is enabled an ASCII X is appended to the end of the IR text string whenever the internal serial buffer overflows. The GC-IRE truncates the current IR signal and waits for a quiet space of 20 ms before transmitting the next IR command.

When operating in compressed mode, repeated on and off pairs are represented in the serial data stream as single uppercase letters, A, B, C, or D. Up to four different pair combinations are condensed from several ASCII characters to only one. The compression process assigns A to represent the first *on*/*off* 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 pair repeats represented by its assigned single letter. To aid compression, *on*/*off* values are consider equivalent if they are within 3 counts of each other reducing undesirable effects of noise and round-off error. The following example highlights alternating pairs to ease reading.

GC-IRE,55000,**22,340**,24,156,**23,92**,23,157,**23,157**,23,92,**23,156**,23,156,**23,157**,23,157,**23,156**,
A B C
23,310**,23,311**,23,156,**24,156**,23,157,**23,157**,23,1375⇐

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D

where A through D are assigned as follows, A = 22,340 B = 24,156 C = 23,92 D = 23,310

as the above IR command will compress to the following:

GC-IRE,55000,22,340,24,156,23,92BBCBBBBB,23,310DBBBB,23,1375⇐

Since the first pair 22,340 never repeats, the letter "A" is not used. Additionally, if the last pair 23,1375 had repeated, it would be sent uncompressed because all four letters are assigned to other pair values. Lastly, the letters are sent without comma delimiters, reducing the original signal from 138 to just 58 characters.

4. Filtering

The GC-IRE contains filtering algorithms to improve performance by removing unwanted IR signals occurring from direct sunlight or fluorescent lighting. Another source of unwanted signals is caused by remote controllers operated from too great a distance, partially blocked by an obstruction, pointed poorly, or in need of fresh batteries. The GC-IRE filtering is not intended to correct a corrupted signal, but to prevent it from being transmitted as serial data. However, when an IR signal is corrupted during transmission, the GC-IRE immediately ends the current IR data output with the letter "Z."

A number of techniques are employed to identify incorrect IR signals, including the minimum acceptable <on> and <off> value of 12. Any time an <on>/<off> value is less than the minimum value the transmission is not sent, or if it is in progress, it is stopped by ending the serial data stream with the letter Z.

5. Serial Interface and Power

GC-IRE utilizes a female DB9 connector to mate directly to the GC-100 and most PCs. From the factory, the GC-IRE is set to 9600 baud, the correct setting to operate with a GC-100. The baud rate can be changed to 19200 or 38400 baud through commands (see Command section.) It is important to note that after sending a baud rate command the GC-IRE will no longer communicate correctly until after the mating device's baud rate is changed to match. The GC-IRE baud rate setting is non-volatile and can only be changed through commands. Therefore, an unknown baud rate setting can only be determined by trial and error until proper communication is established. To change the baud rate when connected to the GC-100, first issue the desired baud rate command. Then select the same baud rate on the GC-100 web page for the serial connector being used by the GC-IRE. Communications should now resume between the GC-IRE and GC-100. Furthermore, after a baud rate change the first character sent may be lost and the command will need to be sent again.

The serial interface is also the power source for the GC-IRE, which operates off the RTS output voltage located on pin 7. The RTS voltage must be between 8 and 25 volts and capable of sourcing 5mA for

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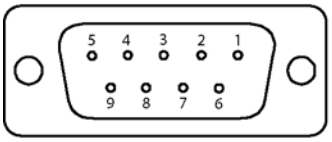
proper operation. Typical RS232 serial drivers will meet this requirement. Also, hardware handshaking (or flow control) must be disabled to avoid RTS voltage interruption.



Female Connector

PIN
2. Receive
3. Transmit
5. Ground
7. RTS power

6. External IR Sensor Interface

Other IR devices, such as Xantech's IR distribution blocks, can connect directly to the GC-IRE. The connection is made using a 3.5mm stereo jack for IR information. Other vendor sensor output levels must be greater than 3 volts and not exceed 24 volts. Connecting an external IR sensor to the GC-IRE bypasses the internal sensor.

1. Ground 2. Signal

7. Commands

The GC-IRE recognizes and responds to commands via the serial connection. Incorrect character sequences followed by a carriage return (↵) will result in an *unknowncommand* response. Commands are case sensitive and listed below.

Commands	Definition	Response	Non-Volatile	Action
gv↵	get version	ver,x.x ⇐	-	-
id↵	identity of device	device,GC-IRE⇐	-	-
tc↵	terminate CR	-	-	text strings end with 0Dh
tl↵	terminate CR LF	-	-	text strings end with 0Dh 0Ah
tn↵	terminate null	-	-	text strings end with 00h
bs↵	baud slow	-	Yes	9600 baud set
bf↵	baud fast	-	Yes	19200 baud set
bF↵	baud Fast	-	Yes	38400 baud set
fy↵	filter yes	filter,ON ⇐	Yes	noise filter enabled
fn↵	filter no	filter ,OFF ⇐	Yes	noise filter disabled

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cy↵	compression yes	compression,ON ⇐	Yes	data compression enabled
cn↵	compression no	compression,OFF ⇐	Yes	data compression disabled

Other	**Definition**	**Response**	**Non-Volatile**	**Action**
-	-	unknowncommand ⇐	-	received invalid command
-	-	X ⇐	-	buffer overflow
-	-	Z ⇐	-	abort signal

Special

gs↵	get state	compression,<X>⇐filter,<X>⇐baud,<B>⇐

where;

<X> is	|ON|OFF|
<B> is	|9600|19200|38400|

Note: The symbol ⇐ represents the termination character used by the ASCII text string response. The factory default termination character is a carriage return (Hex 0d). The termination character can be a carriage return, line feed (Hex 0d 0a) or null character (Hex 00).

Serial commands to the GC-IRE are always terminated by a carriage return (↵) for proper operation.

8. Optimizing Performance

The GC-IRE determines the IR signal simultaneously while transmitting the information serially. To avoid internal data buffer overflows (or loss of data) serial communications must operate fast enough and without interruption. Hence, serial flow control needs to be disabled. The best choice is to use the highest possible baud rate that won't lose data by the receiving device. However, this is not easily determined, except through direct testing. A good rule is to operate at 9600 baud with compression and filtering on. Filtering avoids accepting bad IR signals and sending unnecessary serial data. For baud rates at 19200 and higher, compression is not typically needed. Since flow control is not enabled, one must ensure the receiving device can accept large amounts of data without data loss at these higher baud rates.

IR remote controllers vary in the amount and repeat rate at which IR signals are sent. To determine if the baud rate is fast enough hold down the volume control button to generate a continuous IR signal. If the baud rate is too low, the GC-IRE will not be able to transmit serial data fast enough and IR commands will often be truncated by X ⇐. If this happens often, the baud rate needs to increase or compression must be turned on.

Filtering should always be on in normal use. Filtering is disabled for analyzing an IR sensor installation for unwanted signals cause by sunlight, fluorescent lighting and other IR noise sources. It may also aid in determining the range of the IR remote and help locate the sensor for the best reception. With the filter enabled, many unsatisfactory IR signals are never sent or if the GC-IRE is already transmitting serial data, it is immediately halted and appended by Z ⇐.

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Therefore, a Z ⇐ is an indication of IR noise in the environment while an X ⇐ indicates issues with transmitting serial data too slow, triggering an internal buffer overflow. The loss of IR signals happens frequently when using an IR remote controller with televisions and audio equipment. The occasional loss of IR signals with or without the GC-IRE will not affect the user's experience.

9. Specifications

Serial Interface

Connector	Female DB9
Baud rate	9600, 19200, 38400 baud
Other	No parity, one stop bit
Flow Control	None
Power	Supplied by RTS (pin 7) — must be 8 to 25 volts @ 5mA

Auxiliary IR Sensor interface

Connector	3.5mm stereo jack, 2 conductors, (signal and ground)
Data rate	32 to 500 KHz
Power	Not supplied

Encoding	Comma delimited ASCII text string with termination character.

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