

Garmin GCX Firmware

File Format

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Garmin GCX Firmware File Format

Filename extension *.gcx

This documentation is based on own research and the sources listed in the references section.

Basic data types

All values are serialized in little-endian byte order (least significant byte first) if not mentioned otherwise.

Type	Length	Description
char	1	ASCII character (see [1])
byte	1	8 bit unsigned integer (range 0 .. 255)
ushort	2	16 bit unsigned integer (range 0 .. 65535)
uint	4	32 bit unsigned integer (range 0 .. 4294967295)
string	1..n	0-terminated string (may be empty).

string[n]:

A string of maximum length n. After the 0-terminator, the remaining space is filled with 0.

First variant

General file structure

File Header	
Obfuscated payload	Containing the firmware

File Header

Offset	Type	Content
0	char[]	Signature = "GARMIN1X"
8	uint	If Content is big endian firmware = 0x1C0B8DD6 Else: Some checksum or CRC?
12	uint	If Content is big endian firmware = 0x0000DDE0 Else: Length (total length of file in byte). Is a multiple of 4.
16	ushort	Content 0: Little endian firmware 1: Big endian firmware 16: IGRF model parameters
18	string[16]	Part number, e.g. "006-B2304-32"
34	string[8]	Version, e.g. "6.76"
42	byte	Unknown2 Seen values 2 (with firmware) and 6 (with IGRF model parameters)
43	byte	XOR byte, values seen 0x41 = 'A', 0x49 = 'I' and 0x52 = 'R' Used for obfuscating the payload.

Payload structure for little endian firmware

Offset	Type	Content
0	8 x uint	32 bit little endian ARM instructions
32	uint	Length (total length of payload in byte) Is a multiple of 4.
36	uint	Some checksum or CRC?
40	string[16]	Part number, e.g. "006-B2304-32"
56	string[8]	Version, e.g. "6.76"
64	string[12]	Device name, e.g. "G5"
76	string[28]	Firmware component, e.g. "System Software"
104	string	Copyright, e.g. "(c) 2016-2020 Garmin Ltd. or its subsidiaries"
	byte...	Little endian firmware code

Payload structure for big endian firmware

Offset	Type	Content
0	uint	= big endian 0x0000DDAC
4	uint	= big endian 0x402F0400
8	8 x uint	32 bit big endian ARM instructions
40	uint	= little endian 0x0000DDDB4

Offset	Type	Content
44	uint	= little endian 0xAEC119CE
48	string[16]	Part number, e.g. "006-B2304-BC"
64	string[8]	Version, e.g. "2.40"
72	string[12]	Device name, e.g. "G5"
84	string[28]	Firmware component, e.g. "Bootblock Software"
112	string	Copyright, e.g. "(c) 2015-2022 Garmin Ltd. or its subsidiaries"
	byte...	Big endian firmware code

Payload structure for IGRF model parameters

For IGRF see [2].

Offset	Type	Content
0	uint	Some checksum or CRC?
4	uint	Length (length of payload in byte starting here, i.e. total length - 4) Is 1712 (48 header + 208 lines x 2 params x 4 float)
8	string[13]	Part number, e.g. "006-B2304-32"
21	string[23]	"IGRF MODEL PARAMETERS "
44	uint	Some checksum or CRC?
48	uint	Edition of the model. Seen value 13, means IGRF-13, released in December 2019 and valid from 1900 to 2025.
52	Model parameters: These values are the last two columns in [3]	
208 x line	4 x float	IGRF g, SV g, IGRF h, SV h

Second variant

General file structure

File Header	
Obfuscated payload	Containing the firmware

File Header

Offset	Type	Content
0	char[]	Signature = "GARMINX"
7	uint	Length (total length of file in byte minus 0x1B)
11	uint	Seen values 9, 38 and 181
15	byte	XOR byte, values seen 0x43 = 'C' Used for obfuscating the payload.

Payload structure

Offset	Type	Content
0	byte[2]	=0
2	string[7]	Version, e.g. "3.30"
9	byte[2]	=0
11	byte[20]	?
31	string[13]	Part number, e.g. "006-B1788-01"
44	string[3]	"ON"
47	string[7]	Version, e.g. "3.30"
54	string[37]	Name, e.g. "GTR20X SYS System Software"
91	uint	Length, = size from Header - 0x80, which is payload size - 0xB (maybe the header of the payload structure is 0x80 = 128 byte long)
	byte ...	Empty (filled with 0)
	byte ...	Firmware code

References

Used sources of information

- none -

Standards and specifications

- [1] ISO/IEC 646:1991, Information technology – ISO 7-bit coded character set for information interchange
- [2] IGRF (International Geomagnetic Reference Field)
https://en.wikipedia.org/wiki/International_Geomagnetic_Reference_Field
- [3] IGRF-13 model parameters <https://www.ngdc.noaa.gov/IAGA/vmod/coeffs/igrf13coeffs.txt>

Sources of sample files

For first variant:

- [4] https://www8.garmin.com/support/download_details.jsp?id=10354 G5 Electronic Flight Instrument (Other Operating Systems) software
- [5] https://web.archive.org/web/20170607135756/www8.garmin.com/support/download_details.jsp?id=10354 dito, older version 3.20
- [6] https://www8.garmin.com/support/download_details.jsp?id=10739 G5-STC Electronic Flight Instrument (Microsoft Windows Installer) software

For second variant:

- [7] https://www8.garmin.com/support/download_details.jsp?id=6567 GTR 200
- [8] https://www8.garmin.com/support/download_details.jsp?id=15904 GTR 200-STC