Gillham code

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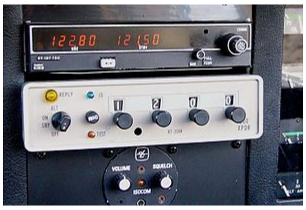
Gillham code is a digital code using an eleven-wire interface that is used to transmit uncorrected barometric altitude between an encoding altimeter or analog air data computer and a transponder. It is a modified form of a Gray code and is sometimes referred to as a "Gray code" in avionics literature.[1]

The code was named in memory of the late Ronald Lionel Gillham, the UK's representative to the IATA committee developing the specification for the second generation of Air Traffic Control System, known in the UK as "Plan Ahead", who died suddenly in March 1968. Mr Gillham was said to have had the idea of using a modified Gray code while at a family dinner.[*citation needed*]

The Gillham code's only application is in the transmission of height information from an altitude encoder to an secondary surveillance radar (SSR) transponder as used in aircraft.[*citation needed*]

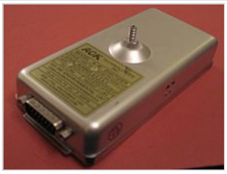
Gillham code



A Cessna ARC RT-359A transponder (the beige box) in the instrument panel of an American Aviation AA-1 Yankee light aircraft. The transponder gets its altitude information from an encoding altimeter mounted behind the instrument panel that communicates via the Gillham code.

Altitude encoder

An altitude encoder takes the form of a small metal box containing a pressure sensor and signal conditioning electronics.[2][3] The pressure sensor is often heated, which requires a warm-up time during which height information is either unavailable or inaccurate. Older style units can have a warm-up time of up to 10 minutes; more modern units warm up in less than 2 minutes. Some of the very latest encoders incorporate unheated 'instant on' type sensors. During the warm-up of older style units the height information may gradually increase until it settles at its final value. This is not normally a problem as the power would typically be applied before the aircraft enters the runway and so it would be transmitting correct height information soon after take-off.[4]



A typical altitude encoder, the ACK Technologies A-30. Note the 15-way D-type connector to send the Gillham code to the transponder and the port on the top of the case that connects to the aircraft's static pressure system.

A common configuration is for the transponder to supply power to the encoder only in the altitude reporting (mode C) setting. This could be problematic if mode C is selected in flight as the warm-up time would start from that point. Height information may not then be transmitted to the SSR station for up to 10 minutes. The purpose of the encoder supply switching via the transponder is to reduce power consumption. Typically an encoder will require about 5 W whilst the heater is engaged. The heater cycles on and off during operation and is controlled by the conditioning circuitry. The duty cycle varies according to the ambient temperature conditions.[*citation needed*]

Light aircraft electrical systems are typically 12 V or 28 V. To allow seamless integration with either, the encoder uses a number of open-collector (open-drain) transistors to interface to the transponder. The height information is represented as 11 binary digits in a parallel form using 11 separate lines designated D2 D4 A1 A2 A4 B1 B2 B4 C1 C2 C4.[5] The Gillham code contains a D1 bit but this is unused in practical applications.

Different classes of altitude encoder do not use all of the available bits. All use the A, B and C bits; increasing altitude limits require more of the D bits. Up to and including 30700 ft does not require any of the D bits. This is suitable for most light general aviation aircraft. Up to and including 62700 ft requires D4. Up to and including 126700 ft requires D4 and D2. Note that D1 is never used.[1]

The datum used by altitude encoders is −1200 ft although many will not output anything lower than −1000 ft. Negative flight levels are included in the code to permit altitude measurement at low levels when the ambient pressure is high.[*citation needed*]

Note that the altitude code output by a standard altitude encoder is a pressure altitude. That is to say, it is always with respect to a pressure datum of 1013.2 mBar (hectopascals) or 29.92 inHg. It does not indicate the height above sea level (altitude) or the ground (height). Pressure altitudes are referred to as flight levels and are expressed to the nearest 100 ft. For clarity here is a sample of the Gillham code from 0 ft to 1000 ft; note that 1000 ft is equivalent to a flight level of 10.

ALTITUDE	D1	D2	D4	A1	A2	A4	B1	B2	B4	C1	C2	C4
0	0	0	0	0	0	0	0	1	1	0	1	0
100	0	0	0	0	0	0	0	1	1	1	1	0
200	0	0	0	0	0	0	0	1	1	1	0	0
300	0	0	0	0	0	0	0	1	0	1	0	0
400	0	0	0	0	0	0	0	1	0	1	1	0
500	0	0	0	0	0	0	0	1	0	0	1	0
600	0	0	0	0	0	0	0	1	0	0	1	1
700	0	0	0	0	0	0	0	1	0	0	0	1
800	0	0	0	0	0	0	1	1	0	0	0	1
900	0	0	0	0	0	0	1	1	0	0	1	1
1000	0	0	0	0	0	0	1	1	0	0	1	0

Decoding

The Gillham code is an unusual mix of codes. It is a parallel binary code that uses a Gray code to ensure that there are not multiple bit changes between adjacent altitudes. The bit pattern is split into those bits used to indicate the number of 500 ft increments and those used to indicate the number of 100 ft increments. The split is as follows.[*citation needed*]

Bits D1–B4 use a standard Gray code to store the number of 500 ft increments.[5]

Bits C1–C4 use a non-linear reflected Gray code to store the number of 100 ft increments +1. The values when converted to decimal follow this repeating pattern: 1 2 3 4 7 7 4 3 2 1 1 2 3 4 7 ....[*citation needed*]

The C bits must be converted from Gray to standard binary, the 7 changed to a 5 and the reflected order changed when the 500 ft increment is even.[*citation needed*]

The number resulting from combining the above gives the flight level above the minimum datum (−1200 ft). This offset must be removed to give a corrected altitude value.[*citation needed*]

The Gillham code can be decoded using various methods. Standard techniques use hardware [6] or software solutions. The latter often uses a lookup table but an algorithmic approach can be taken.[7]

References

1. ^ ***a b*** List of altitudes and Gillham codes (http://www.airsport-corp.com/modecascii.txt)
2. ^ Ameriking AK-350 Altitude Encoder (http://www.ameri-king.com/altitude_encoder.html)
3. ^ ACK A-30 Altitude Encoder (http://www.ackavionics.com/products.htm)