



Fig 19.10: The Feld-Hell Spectrogram

Symbol Rate	112.5 baud
Typing Speed	25WPM
Bandwidth	350Hz
ITU-R Description	350HA1C

Table 19.4: Hellschreiber summary

in the 1930s, was an audio sub-carrier mode, and was soon sent by radio, predating RTTY for this purpose by at least 15 years. The mode was used to send press traffic right up to the 1960s.

Developed by Rudolf Hell [13], the technique involves sending each character as a pattern of timed dots, rather like a dot matrix printer [14]. Black dots are sent (key down) and white spaces are not sent (key up) by scanning each character vertically upwards, then moving along from left to right at a constant rate. The column data can be analogue, but typically consists of 14 black or white dot positions per column, and seven columns per character, including the space between characters. Each character takes 400ms to send, so the typing speed is about 25WPM. At the receiver, the incoming dots are presented to the reader as dots of varying greyness according to signal strength, allowing the reader to discern the transmitted text by eye, and so enabling text to be recognised in the presence of considerable noise.

A number of clever techniques were developed to improve reception and minimise transmission bandwidth. For example, the received dots are displayed twice, spaced vertically, making synchronisation unnecessary. The font developed by Hell did not permit individual pixels to be sent, rather at least two were sent consecutively, so the characters could have 14 x 7 resolution with the bandwidth of a 7 x 7 font. These features are retained today in PC sound card software for Hellschreiber. Modern techniques include rendered characters (grey pixels on corners), raised cosine dot shaping for minimum bandwidth, and proportional fonts, which are faster to send.

The most popular Hell mode is the original one used over military radio links from 1944 by portable mechanical machines such as the Siemens A2, and for that reason is called Feld-Hell. The signal is on/off keyed at 122.5 baud with carefully shaped dots, and has a bandwidth of about 350Hz. Feld-Hell is especially useful on noisy bands, and because the transmitter duty cycle is only about 20%, is ideally suited to QRP and portable operation. It is badly affected by multi-path, which causes interesting ghosting effects. These can often be minimised by careful adjustment of receiver gain. Another popular mode is FM-Hell, developed by Nino Porcino IZ8BLY, which uses minimum shift keying (MSK), has similar bandwidth, but is more robust and sensitive. FM-Hell is not so affected by multi-path, but operates the transmitter at 100% duty cycle.

A spectrogram of a Feld-Hell signal is shown in **Fig 19.10**, and **Table 19.4** shows a summary of the specification.

There are many free software packages for Hellschreiber modes, the most popular being IZ8BLY Hellschreiber, written by Nino Porcino IZ8BLY. This software includes several other interesting Hell-related modes. Hell signals can be found on most bands, and is most popular on 80m and 20m. Check around 14.075MHz.

HELLSCHREIBER

There is a grey area (pun intended) between digital data modes (such as RTTY and PSK31) and analogue data modes (such as SSTV or HFFAX), of modes which cannot adequately be described as totally analogue or totally digital.

Arguably, Morse is one of these modes, because while it is apparently a digital transmission, reception occurs at an analogue human-readable level. For example, experienced Morse operators can identify the sender by his 'fist', can read the signal better than any electronic means, and can tell much about propagation and the transmitter from the sound of the signal.

Of the other modes in this category, Hellschreiber is the favourite. The term Fuzzy Modes has been coined to describe these modes with both analogue and digital features. Fuzzy modes use the human brain to assist in interpretation of an analogue presentation of the received signal, rather than electronic decisions made by hardware or computer.

While Hellschreiber is a relatively recent arrival on the amateur scene, its origins are old. It was developed as a means of sending press messages by telephone line. Hellschreiber, even