Hell Formats

Just what are all these different formats? Here is a simple definition of all the Hellschreiber modes, and where they are or were used.

 *Those marked with a tick are in current use.*

On-Off Keyed (ASK) Modes

F-Hell, Press-Hell

This quasi-synchronous system used a 14 x 7 font field the same as Feld-Hell, and transmitted the standard Hell font at 245 baud or 5 characters/sec. Transmission was originally baseband (current keyed) and later 1000 Hz tone keyed. In all respects but speed, this system is essentially identical to the widely used Feld-Hell mode. F-Hell can be transmitted by the IZ8BLY V2.7 software (speed E).

Feld-Hell

The most well known and widely used system still, the quasi-synchronous Feld-Hell format was first used by the Siemens & Halske Feldfernschreiber (Field Teleprinter) - over 30,000 were probably made. A 14 x 7 font field is used, and the standard Hell font is sent at 122.5 baud (2.5 characters/sec). Transmissions are 900 Hz tone keyed, although most software systems now use 980 Hz (baud rate x 8). This is the mode to use on HF - or at least for all CQ calls.

GL-Hell

The GL-Hell system uses a similar 14 x 7 font field as Feld-Hell, but the characters in the font are modified by the addition of a "bar" up the left side, which acts as a "start bit", because this is an asynchronous system. Operation is at 300 baud (6.1 characters/sec), and either 1000 or 3000 Hz keyed tones were used. The Siemens model 72c was for many years used by the German Army and Railways, and was taken up by Amateurs for VHF use. Even today some GL-Hell is sent by European Amateurs on 2m. GL-Hell is not useful on HF, where it has synchronism problems. Only a few computer programs offer GL-Hell mode.

Hell-80

The last of the Hell machines manufactured by Siemens was the solid state Model 80. This machine transmits both quasi-synchronous and asynchronous modes, and uses a completely different font with a 9 x 7 dot field. With 63 dots rather that 49, this format transmits at 315 baud for a throughput of 5 characters/second. This format is FSK only - 1625 Hz white, 1925 Hz black and 1260 Hz for line signalling. Hell-80 is rarely used by Amateurs. There is very little software available.

PC-Hell

Over the years, various Amateurs have experimented with asynchronous Hell transmissions that were compatible with existing RTTY equipment. This technique used the PC UART to transmit asynchronous characters for each character column. Even at 100 baud (as fast as most RTTY equipment would go) the text throughput using a simple 7 x 5 font with one stop bit was under two characters/second. Of course the technique is just as noise prone as RTTY, and suffered more from fading at the faster baud rates.

This may also have been the format of Hell-45, but nothing is at present known of this.

PSK-Hell and FM-Hell

PSK-Hell is an exciting new mode invented in 1999 by Murray ZL1BPU and implemented first by Nino IZ8BLY. FM-Hell, developed by Nino IZ8BLY is technically very similar. These modes have impressive characteristics - very sensitive, rather like PSK-31, but much less affected by polar Doppler flutter and fading. They recover very quickly from lightning pulses due to the huge dynamic range and insensitivity to amplitude variations. FM-Hell suffers less from blurriness and text can look very sharp on poor paths. Sensitivity is really good, giving sharp, noise-free print with very weak signals.

PSK-Hell is a *Differential* Phase Shift Keyed mode. PSK-Hell, like PSK-31, has the idle state signalled by a string of 180° phase changes at the baud rate, with raised cosine envelope, but there the similarity ends. FM-Hell uses MSK (minimum shift keying), and is rather like PSK-Hell but with only one sideband. It combines precise frequency shift with phase shift to achieve a clean very narrow MSK-like single sideband transmission with no raised cosine modulation.

These modes transmit text in either a special low resolution 7 x 6 dot matrix at 105 baud, or a high resolution 14 x 7 dot matrix WINDOWS™ font at 245 baud, so the character throughput and column rate are identical in both cases to Feld-Hell. At 105 baud a special font with an even number of columns is required,in order to control the number of phase reversals in each character. It is not possible to use Rudolf Hell's resolution enhancing "two pixel rule" with 7 vertical pixels, and at 245 baud would not give any bandwidth reduction. Black dots are sent by *not*reversing the phase at the beginning of the dot. The receiving process is identical for PSK-Hell and FM-Hell, and compares the phase of each dot with that of the previous dot. All amplitude variation is ignored (making it insensitive to noise) and the actual phase change is handled in a fuzzy manner, which makes copy easier under poor conditions. With four times oversampling, Doppler phase errors are averaged out by the operator's eye. No clock recovery is required, as the system is an analog one, and quasi-synchronous like Feld-Hell.

FSK-Hell

Various software packages offer FSK versions of Feld-Hell, but none are much used. There appears to be no particular standard, although perhaps the IZ8BLY 245 Hz shift version is the most widespread. This version transmits 980 Hz for black, 1225 Hz for white surrounding the character, and silence for inter-character white, with an option for full-time white.

G3PPT's FELDNEW8 also offers FSK, but transmits full-time white. It is also possible to operate FSK with full-time white using the LA0BX software and an RTTY modem. All programs operate at 122.5 baud.

Duplo-Hell

This is a dual-tone mode invented in 1999 by Nino IZ8BLY. The font and format are identical to Feld-Hell, except that two columns are transmitted at the same time, using two on-off keyed tones.These tones (980 Hz and 1225/1470 Hz for 245/490 Hz shift) are obviously sometimes sent at the same time. The lower tone is used for the left column, and the upper for the right. Rather than operate at double throughput, the transmission runs at the same throughput as Feld-Hell (2.5 characters/sec), with the dot elements doubled in length (61.25 baud).

This mode is remarkably immune to noise, due to the higher integration time for each dot element. The wider shift is more noise immune, but more sensitive to selective fading, which causes a "venetian blind" effect.

Sequential Multi-Tone Hell

A recent invention by ZL1BPU (1998), S/MT-Hell is a compromise between Feld-Hell and C/MT-Hell. Like Feld-Hell, the characters are transmitted in a matrix (in fact the same sequence as Feld-Hell), but different tones are used for each row of dots in the character.The font is restricted to 7 x 5 and the non-transmitted white dots can be of shorter duration (less time wasted on them), since the reception is in the frequency domain using an FFT receiver (waterfall plot). S/MT-Hell is very effective on noisy bands and may provide better sensitivity that C/MT-Hell. See the Sequential MT-Hell page.

Concurrent Multi-Tone Hell

C/MT-Hell was first demonstrated in 1937. Peter G3PLX recently (1998) redeveloped it, using an FFT receiver to display the signal. A few other programmers have followed suit. All rows of each character are transmitted at the same time using multiple different tones, and hence (unlike S/MT-Hell) it is possible to send a truly vertical line. High resolution is possible allowing elaborate fonts to be used. The system is very interference immune, but puts great linearity demands on the transmitter. See the Concurrent MT-Hell page.

Slow-Feld

Intended for beacon use rather than for QSOs, this mode developed by Lionel G3PPT is in reality a *VERY* slow version of Feld-Hell. The traditional font is used, but the transmissions are at an awesome 2 characters/minute! The biggest difference is in the receiving software - a multi-channel FFT receiver is used to coax the signal out of the noise. This approach gives very high sensitivity since the bandwidth of each channel is very narrow. Drift is compensated for through the use of multiple receivers. There are several versions, all intended for LF and HF QRP beacons.

Mode Summary

The table below gives a guide to the use of the different Hell modes under different operating conditions, in different circumstances. "OK" means the mode is useful, "GOOD" means this mode was designed to combat this situation, or copes very well with it. No entry does not mean the mode is bad in this regard, only that there is a better mode. In general, the modes covered are those offered by the widely used IZ8BLY software.

Conditions Copyright (C) M. Greenman 2000	Band	Feld	PSK	FM	FSK	Duplo	MT	Slow
Weak signal DX	LF,MF, HF	OK[1]	GOOD	GOOD	-	OK[1]	-	GOOD
Weak signal DX	VHF	-	GOOD	GOOD	-	-	-	-
Calling CQ DX/Local	LF,MF, HF	GOOD[2]	GOOD	GOOD	-	-	-	-
Poor conditions (fading, lightning noise)	Low HF	-[1]	GOOD	GOOD	OK	OK	GOOD	-
Poor conditions (excessive multi-path)	Low HF	-[1]	OK	GOOD	-	GOOD[3]	OK	-
Deep fading (QSB)	HF	-	GOOD	GOOD	-	YES[3]	-	-
Doppler (polar flutter)	HF	OK	GOOD	GOOD	-	-	-	-
Doppler (satellite, meteor)	VHF/UHF	GOOD[4]	OK[11]	OK[11]	-	-	OK	-
Severe QRM (especially Pactor/RTTY)	HF	-	-	-	OK	OK	GOOD	-
Severe QRM (on-frequency carrier)	HF	-	-	-	-	OK	GOOD	-
Severe QRM (SSB splatter)	HF	OK	OK	OK	-	GOOD	GOOD	-
QRP operation	ALL	OK	GOOD	GOOD	-	-	-	-
Narrow bandwidth (<200 Hz)	ALL	-	105 Hz[12]	55 Hz[12]	-	-	200 Hz	1 Hz
High Resolution for impressive demonstrations	ALL	GOOD[5]	GOOD[11]	GOOD[11]	OK	OK	GOOD[6]	-
Beacon applications	ALL	OK	GOOD	GOOD	-	-	-	GOOD
Lots of spare time for wierd QSOs	ALL	OK[1]	-	-	-	-	-[7]	GOOD
Operating Hell with a CW or QRP rig	ALL	GOOD[8]	-	-	-	-	OK[9]	OK[10]
Using Class C transmitter	ALL	OK	-	GOOD	-	-	GOOD[9]	GOOD[10]

Notes:

1. Use "DX" mode or try slower baud rates
2. Preferred mode for all CQ calls - use 122.5 baud
3. Duplo has better noise rejection than Feld-Hell and can be copied through selective fades
4. Try faster baud rates (say 7.5 char/sec) for meteor scatter, and repeat the letters. Set up memos (macros)
5. Remember that using Windows fonts on Feld-Hell will cause the signal to be rather wide (typically > 1 kHz)
6. G3PLX MT-Hell supports all the Windows fonts and uses 16 tones. IZ8BLY uses 14 tones and Windows fonts. G3PPT uses 9 tones in MTHKBD2, and it looks good, but has a fixed font.
7. Try Sequential MT-Hell, such as Mosaic II, at 1 dot/sec
8. Use LA0BX software and a Hamcomm interface to key the rig
9. Add a D-A converter to the VCO and use S/MT-Hell (MOSAIC II)
10. Use an audio tone keyer and G3PPT software
11. In 245 baud mode
12. In 105 baud mode

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