# Specifications

Data without tolerances are typical values.

## Analog analyzers

For analog measurements two analyzers with different bandwidths, specifications and measurement functions are available:

| Analyzer | Frequency range |
|---|---|
| ANLG 22 kHz | DC/10 Hz to 21.90 kHz[1] |
| ANLG 110 kHz | DC/20 Hz to 110 kHz[1] |

Level measurements (rms)

| | |
|---|---|
| Accuracy at 1 kHz | ±0.05 dB |
| Frequency response ref. to 1 kHz) | |
| 20 Hz to 22 kHz | ±0.03 dB, typ. 0.003 dB ($V_{in}$<3 V) |
| 10 Hz to 20 Hz | ±0.1 dB |
| 22 kHz to 50 kHz | ±0.1 dB |
| 50 kHz to 110 kHz | ±0.2 dB |

### Inputs

| | |
|---|---|
| **XLR connectors** | 2 channels, balanced (unbalanced measurements possible with XLR/BNC Adapter UPL-Z1), floating/grounded and AC/DC coupling switchable |
| Voltage range | 0.1 µV to 110 V (rms, sine) |
| Measurement ranges | 18 mV to 100 V, in steps of 5 dB |
| Input impedance | 100 kΩ±1% shunted by 120 pF, each pin against ground 300 Ω, 600 Ω, ±0.5% each, $P_{max}$ 1 W |
| Crosstalk attenuation | >120 dB, frequency <22 kHz, 600 Ω |
| Common-mode rejection ($V_{in}$ <3 V) | >100 dB at 50 Hz, >86 dB at 1 kHz, >80 dB at 16 kHz |
| **Generator output** | each input channel switchable to the other output channel, input impedance: balanced 200 kΩ, unbalanced 100 kΩ |
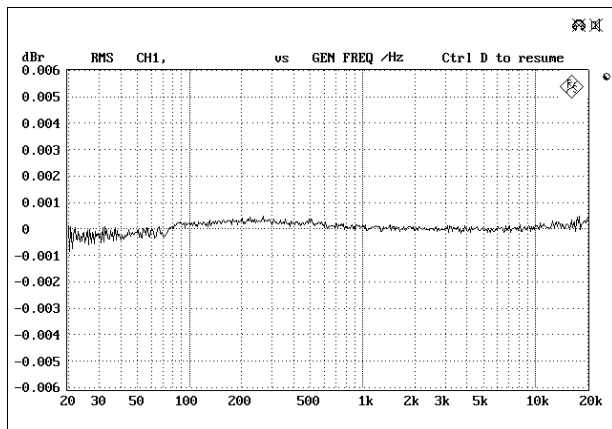


Typical frequency response, measured with internal generator/analyzer at analog interfaces

### Measurement functions

**RMS value, wideband**
Accuracy

| | |
|---|---|
| Measurement speed | |
| AUTO | ±0.05 dB at 1 kHz, sine |
| AUTO FAST | ±0.1 dB additional error |
| Integration time | |
| AUTO FAST/AUTO | 4.2 ms/42 ms, at least 1 cycle |
| VALUE | 1 ms to 10 s |
| GEN TRACK | 2.1 ms, at least 1 cycle |
| Noise (600 Ω) | |
| with A filter | 1 µV |
| with CCIR unweighting filter | <2 µV, 1.6 µV typ. (ANLG 22 kHz) |
| Filter | weighting filters and user-definable filters, up to 3 filters can be combined, analog notch filter in addition (expansion of dynamic range by up to 30 dB) |
| Spectrum | post-FFT of filtered signal |

[1] DC/AC coupling.

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**RMS value, selective**

| | |
|---|---|
| Bandwidth (–0.1 dB) | 1%, 3%, 1/12 octave, 1/3 octave and user-selectable fixed bandwidth, minimum bandwidth 20 Hz |
| Selectivity | 100 dB (80 dB) with analyzer ANLG 22 kHz (110 kHz) bandpass or band-stop filter, 8th order elliptical filter, analog notch filter in addition |
| Frequency setting | – automatic to input signal<br>– coupled to generator<br>– fixed through entered value<br>– sweep in selectable range |
| Accuracy | ±0.2 dB + ripple of filters |
| **Peak value** | with analyzer ANLG 22 kHz only |
| Measurement | peak max, peak min, peak-to-peak, peak absolute |
| Accuracy | ±0.2 dB at 1 kHz |
| Interval | 20 ms to 10 s |
| Filter[2] | weighting filters and user-definable filters, up to 3 filters can be combined |
| **Quasi-peak** | with analyzer ANLG 22 kHz only |
| Measurement, accuracy | to CCIR 468-4 |
| Noise (600 Ω) | <8 µV with CCIR weighting filter |
| Filter[2] | weighting filters and user-definable filters, up to 3 filters can be combined, analog notch filter in addition |
| **DC voltage** | |
| Voltage range | 0 V to ±110 V |
| Accuracy | ±(1% of measured value + 0.1% of measurement range) |
| Measurement ranges | 100 mV to 100 V, in steps of 10 dB |
| **S/N measurement routine** | available for measurement functions<br>– rms, wideband<br>– peak<br>– quasi-peak<br>indication of S/N ratio in dB, no post-FFT |
| **FFT analysis** | see FFT analyzer section |

**Total harmonic distortion (THD)**

| | | |
|---|---|---|
| Fundamental | | 10 Hz to 22 kHz |
| Frequency tuning | | automatic to input or generator signal or fixed through entered value |
| Weighted harmonics | | any combination of $d_2$ to $d_9$, up to 110 kHz |
| Accuracy | | |
| Harmonics | <50 kHz | ±0.5 dB |
| | <110 kHz | ±0.7 dB |
| Inherent distortion[3][4] | | |
| Analyzer ANLG 22 kHz | | |
| Fundamental | 20 Hz to 10.95 kHz | <–110 dB, typ. –115 dB |
| | 10 Hz to 20 Hz | <–100 dB |
| Analyzer ANLG 110 kHz | | |
| Fundamental | 50 Hz to 20 kHz | <–100 dB, typ. –105 dB |
| Spectrum | | bar chart showing signal and distortion |

**THD+N and SINAD**

| | | |
|---|---|---|
| Fundamental | | 10 Hz to 22 kHz |
| Frequency tuning | | automatic to input or generator signal or fixed through entered value |
| Input voltage | | typ. >100 µV with automatic tuning |
| Bandwidth | | upper and lower frequency limit selectable, one weighting filter in addition |
| Accuracy | | |
| Bandwidth | <50 kHz | ±0.5 dB |
| | <100 kHz | ±0.7 dB |
| Inherent distortion[3] | | |
| Analyzer ANLG 22 kHz | | |
| Bandwidth | 20 Hz to 21.90 kHz | typ. –110 dB at 1 kHz, 2.5 V<br><–105 dB +2 µV [5]<br>typ. –108 dB +1.5 µV |
| Analyzer ANLG 110 kHz | | |
| Bandwidth | 20 Hz to 22 kHz | <–95 dB + 2.5 µV, typ. –100 dB +1.75 µV |
| | 20 Hz to 110 kHz | <–88 dB + 5 µV, typ. –95 dB + 3.5 µV |
| Spectrum | | post-FFT of filtered signal |

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[2] With UPL-B29 only in base rate mode.

[3] Total inherent distortion of analyzer and generator (with option UPL-B1), analyzer with dynamic mode precision.

[4] >3.5 V: typ. 3 dB less; <0.5 V: sensitivity reduced by inherent noise (typ. 0.25/1.25 µV with analyzers 22/110 kHz).

[5] At full-scale level of measurement range (<–100 dB + 2 µV with auto range), <–100 dB for input voltage >3.5 V.

**Modulation factor (MOD DIST)**

| | |
|---|---|
| Measurement method | selective to DIN IEC 268-3 |
| Frequency range | lower frequency    30 Hz to 2700 Hz |
| | upper frequency    8 x LF to 100 kHz[1] |
| Accuracy | ±0.50 dB |
| Inherent distortion[2] | |
| Upper frequency   4 kHz to 15 kHz | <–96 dB (–90 dB), typ. –103 dB |
| 15 kHz to 20 kHz | <–96 dB (–85 dB) |
| Spectrum | bar chart showing signal and distortion |

**Difference frequency distortion (DFD)**

| | | |
|---|---|---|
| Measurement method | | selective to DIN IEC 268-3 or 118 |
| Frequeny range | | difference frequency 80 Hz to 2 kHz |
| | | center frequency    200 to 100 kHz[3] |
| Accuracy | | ±0.50 dB, center frequency <20 kHz |
| Inherent distortion[4] | DFD $d_2$ | <–112 dB, typ. –125 dB |
| | DFD $d_3$ | <–96 dB, typ. –105 dB |
| Spectrum | | bar chart showing signal and distortion |

**Wow and flutter**

| | | |
|---|---|---|
| | | with analyzer ANLG 22 kHz only |
| Measurement method | | DIN/IEC, NAB, JIS, |
| | | 2-sigma to IEC-386 |
| Weighting filter | OFF | highpass 0.5 Hz, bandwidth 200 Hz |
| | ON | bandpass 4 Hz to IEC-386 |
| Accuracy | | ±3% |
| Inherent noise | | <0.0005% weighted |
| | | <0.001%   unweighted |
| Spectrum | | post-FFT of demodulated signal |

**Time domain display (WAVEFORM)**

| | |
|---|---|
| Trigger | rising/falling edge |
| Trigger level | –200 V to +200 V, interpolated between samples |
| Trace length | max. 7424 points |
| Standard mode | 1- to 32-fold interpolation |
| Compressed mode | 2- to 1024-fold compression (envelope for AGC measurement), with analyzer ANLG 22 kHz only |

**Frequency** [5]

| | |
|---|---|
| Frequency range | 20 Hz to 110 kHz |
| Accuracy | ±50 ppm |

**Phase** [5]

| | |
|---|---|
| | with analyzer 22 kHz only |
| Frequency range | 20 Hz to 20 kHz |
| Accuracy | ±0.5° |

**Group delay** [5]

| | |
|---|---|
| | with analyzer 22 kHz only |
| Frequency range | 20 Hz to 20 kHz |
| Accuracy in seconds | $\Delta\varphi/(\Delta f \times 360)$, where $\Delta\varphi$ = phase accuracy in °, $\Delta f$ = frequency step |

**Polarity test**

| | |
|---|---|
| Measurement | polarity of unsymmetrical input signal |
| Display | +POL, –POL |

## Analog generators

An 18-bit $\Delta\Sigma$ D/A converter is used for analog signal generation. The characteristics of the basic generator can be improved and extended with a low-distortion RC oscillator (Low Distortion Generator UPL-B1):
– sine with reduced distortion
– frequency range up to 110 kHz

### Outputs

XLR connectors, 2 channels, floating, balanced/unbalanced switchable, short-circuit-proof; max. current <120 mA with external feed

**Balanced**

| | |
|---|---|
| Voltage | 0.1 mV to 20 V (rms, sine, open-circuit) |
| Crosstalk attenuation | >115 dB, frequency <20 kHz |
| Source impedance | typ. 10 Ω , 200 Ω (150 Ω with UPL-U3) ± 0.5%, 600 Ω ± 0.5% |
| Load impedance | >400 Ω (incl. source impedance) |
| Output balance | >75 dB at 1 kHz, >60 dB at 20 kHz |

**Unbalanced**

| | |
|---|---|
| Voltage | 0.1 mV to 10 V (rms, sine, open-circuit) |
| Crosstalk attenuation | >115 dB, frequency <20 kHz |
| Source impedance | 5 Ω |
| Load impedance | >200 Ω |

### Signals

**Sine**

| | | |
|---|---|---|
| Frequency range | | 2 Hz to 21.75 kHz |
| Frequency accuracy | | ±50 ppm |
| Level accuracy | | ±0.1 dB at 1 kHz |
| Frequency response (ref. to 1 kHz) | | |
| 20 Hz to 20 kHz | | ±0.05 dB |
| Inherent distortion THD+N | | |
| Measurement bandwidth | | |
| 20 Hz to 22 kHz | | <–94 dB, typ. –98 dB |
| 20 Hz to 100 kHz | | <–86 dB |
| Sweep parameters | | frequency, level |

**Sine (with low distortion generator option)**

| | | |
|---|---|---|
| Frequency range | | 10 Hz to 110 kHz |
| Frequency accuracy | | ±0.5% at 15°C to 30°C |
| | | ±0.75% at 5°C to 45°C |
| Level accuracy | | ±0.1 dB at 1 kHz |
| Frequency response (ref. to1 kHz) | | |
| 20 Hz to 20 kHz | | ±0.05 dB |
| 10 Hz to 110 kHz | | ±0.1 dB |
| Harmonics | | typ. <–115 dB (<–120 dB at 1 kHz), measurement bandwidth 20 Hz to 20 kHz, voltage 1V to 5 V |
| Inherent distortion (THD) | | |
| Fundamental | 1 kHz, 1 V to 10 V | <–120 dB typ. |
| | 20 Hz to 7 kHz | <–105 dB |
| | 7 kHz to 20 kHz | <–100 dB |

| Inherent distortion (THD+N)[6] | | | Meas. bandw. |
|---|---|---|---|
| Fundamental | 1 kHz, 2.5 V | –110 dB typ. | 22 kHz |
| | 20 Hz to 20 kHz | <–100 dB +2 μV | 22 kHz |
| | 20 Hz to 20 kHz | <–88 dB +5 μV | 100 kHz |
| Sweep parameters | | frequency, level | |

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[1]  For upper frequency >20 kHz, the bottom limit of lower frequency is reduced.

[2]  Input voltage >200 mV, typical values apply between 0.5 V and 3.5 V. Lower frequency >200 Hz, values in ( ) for lower frequency <200 Hz. Dynamic mode precision; level ratio LF:UF = 4:1.

[3]  For center frequencies >20 kHz the bottom limit of the difference frequency is reduced.

[4]  Input voltage >200 mV, typical values apply between 0.5 V and 3.5 V, dynamic mode precision (at DFD d2), center frequency 7 kHz to 20 kHz.

[5]  With measurement functions RMS, FFT and THD+N only, accuracy applies to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB.

[6]  Total inherent distortion of analyzer and generator, analyzer with dynamic mode precision.
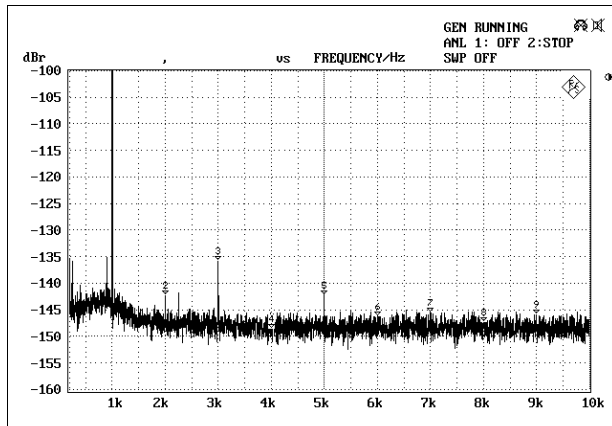
Typical spectrum of low distortion generator at 1 kHz, 1 V

| **MOD DIST** | | for measuring the modulation distortion |
|---|---|---|
| Frequency range | lower frequency | 30 Hz to 2700 Hz |
| | upper frequency | 8 x LF to 21.75 kHz |
| Level ratio (LF:UF) | | selectable from 10:1 to 1:1 |
| Level accuracy | | ±0.5 dB |
| Inherent distortion | | <–94 dB (typ. –100 dB) at 7 kHz, 60 Hz |
| | | <–84 dB (typ. –90 dB), |
| | | level ratio LF:UF = 4:1 |
| Sweep parameters | | upper frequency, level |

| **DFD** | | for measuring the difference tone |
|---|---|---|
| Frequency range | difference freq. | 80 Hz to 2 kHz |
| | center frequency | 200 Hz to 20.75 kHz |
| Level accuracy | | ±0.5 dB |
| Inherent distortion[1] | DFD $d_2$ | <–114 dB, typ.–120 dB |
| | DFD $d_3$ | < –92 dB, typ. –100 dB |
| Sweep parameters | | center frequency, level |

**Multi-sine**

| | |
|---|---|
| Frequency range | 2.93 Hz to 21.75 kHz |
| Frequency spacing | adjustable from 2.93 Hz |
| Frequency resolution | <0.01% or matching FFT frequency spacing |
| Dynamic range | 100 dB, referred to total peak value |
| Characteristics | |
| Mode 1 | 1 to 17 spectral lines |
| | – level and frequency selectable for each line |
| | – phase of each component optimized for minimum crest factor |
| | – phase of each component or crest factor selectable (with UPL-B6) |
| Mode 2 | 1 to 7400 spectral lines (noise in frequency domain), distribution: white, pink, 1/3 octave, defined by file; crest factor selectable (with UPL-B6) |

**Sine burst, sine² burst**

| | |
|---|---|
| Burst time | 1 sample up to 60 s, 1-sample resolution |
| Interval | burst time up to 60 s, 1-sample res. |
| Low level | 0 to burst level, absolute or relative to burst level (0 with sine² burst) |
| Bandwidth | 21.75 kHz (elliptical filter) |
| Sweep parameters | burst frequency, level, time, interval |

**Noise**

| | |
|---|---|
| Distribution | Gaussian, triangular, rectangular |

**Arbitrary waveform** — loaded from file

| | |
|---|---|
| File format | |
| *.TTF (internal) | memory depth max. 16 k |
| *.WAV [2] | reproduction of audio files (mono), duration approx. 10 s per Mbyte RAM |
| Clock rate | 48 kHz |
| Bandwidth | 21.75 kHz (elliptical filter) |

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[1] Center frequency >5 kHz, difference frequency <1 kHz; DFD d2 –100 dB (typ.) with DC offset.

[2] With UPL-B29 only in base rate mode.

**Polarity test signal**
Sine² burst with following characteristics:

| | |
|---|---|
| Frequency | 1.2 kHz |
| On-time | 1 cycle (0.8333 ms) |
| Interval | 2 cycles (1.6667 ms) |

**FM signal**

| | |
|---|---|
| Carrier frequency | 2 Hz to 21.75 kHz |
| Modulation frequency | 1 mHz to 21.75 kHz |
| Modulation | 0% to 100% |

**AM signal**

| | |
|---|---|
| Carrier frequency | 2 Hz to 21.75 kHz |
| Modulation frequency | 1 mHz to 21.75 kHz |
| Modulation | 0% to 100% |

**DC voltage**

| | |
|---|---|
| Level range | 0 V to ±10 V (±5 V unbalanced), sweep possible |
| Accuracy | ±2% |

**DC offset[3]**

| | |
|---|---|
| | 0 V to ±10.0 V (±5 V unbalanced) |
| Accuracy | ±2% |
| Residual offset | <1% of rms value of AC signal |

## Digital analyzer (option UPL-B2 or -B29)

Frequency limits specified for measurement functions apply to a sampling rate of 48 kHz. For other sampling rates limits are calculated according to the formula: $f_{new} = f_{48 kHz}$ x sampling rate/48 kHz.

### Inputs

| | |
|---|---|
| Balanced input | XLR connector, transformer coupling |
| Impedance | 110 Ω |
| Level ($V_{PP}$) | min. 200 mV, max. 12 V |
| Unbalanced input | BNC, grounded |
| Impedance | 75 Ω |
| Level ($V_{PP}$) | min. 100 mV, max. 5 V |
| Optical input | TOSLINK |
| Channels | 1, 2 or both |
| Audio bits | 8 to 24 |
| Clock rate | 35 kHz to 55 kHz with UPL-B2 or UPL-B29 in base rate mode |
| | 35 kHz to 106 kHz with UPL-B29 in high rate mode |
| | synchronous to DAI or DARS |
| Format | professional and consumer format to AES3 or IEC-958 as well as user-definable formats at all inputs |

### Measurement functions

All measurements at 24 bits, full scale

**RMS value, wideband**

| | |
|---|---|
| Measurement bandwidth | up to 0.5 times the clock rate |
| Accuracy | |
| AUTO FAST | ±0.1 dB |
| AUTO | ±0.01 dB |
| FIX | ±0.001 dB |
| Integration time | |
| AUTO FAST/AUTO | 4.2 ms/42 ms, at least 1 cycle |
| VALUE | 1 ms to 10 s |
| GEN TRACK | 2.1 ms, at least 1 cycle |
| Filter | weighting filters and user-definable filters, up to 3 filters can be combined |
| Spectrum | post-FFT of filtered signal |

**RMS value, selective**

| | |
|---|---|
| Bandwidth (–0.1 dB) | 1%, 3%, 1/12 octave, 1/3 octave and user-selectable fixed bandwidth, min. bandwidth 20 Hz |
| Selectivity | 100 dB, bandpass or bandstop filter, 8th order elliptical filter |

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[3] No DC offset for signal generation with Low Dist ON. With DC offset the AC voltage swing will be reduced, specified inherent distortion values apply to DC offset = 0.

| Frequency setting | – automatic to input signal |
| | – coupled to generator |
| | – fixed through entered value |
| | – sweep in selectable range |
| Accuracy | ±0.2 dB + ripple of filters |

### Peak value
| Measurement | peak max, peak min, peak-to-peak, peak absolute |
| Accuracy | ±0.2 dB at 1 kHz |
| Interval | 20 ms to 10 s |
| Filter[1] | weighting filters and user-definable filters, up to 3 filters can be combined |

### Quasi-peak
| Measurement, accuracy | to CCIR 468-4 |
| Filter[1] | weighting filters and user-definable filters, up to 3 filters can be combined |

### DC voltage
| Measurement range | 0 to ±FS |
| Accuracy | ±1% |

### S/N measurement routine
| | available for measurement functions: |
| | – rms, wideband |
| | – peak |
| | – quasi-peak |
| | indication of S/N ratio in dB, no post-FFT |

### FFT analysis
| | see FFT analyzer section |

### Total harmonic distortion (THD)
| Fundamental | 10 Hz to 21.90 kHz |
| Frequency tuning | automatic to input or generator signal or fixed through entered value |
| Weighted harmonics | any combination of $d_2$ to $d_9$, up to 21.90 kHz |
| Accuracy | ±0.1 dB |

Inherent distortion[2]
| Fundamental | 42 Hz to 21.90 kHz | <–130 dB |
| | 24 Hz to 42 Hz | <–112 dB |
| | 12 Hz to 24 Hz | <–88 dB |
| Spectrum | | bar chart showing signal and distortion |

### THD+N and SINAD
| Fundamental | 10 Hz to 21.90 kHz |
| Frequency tuning | automatic to input or generator signal or fixed through entered value |
| Stopband range | fundamental ±28 Hz, max. up to 2nd harmonic |
| Bandwidth | upper and lower frequency limit selectable, one weighting filter in addition |
| Accuracy | ±0.3 dB |

Inherent distortion [2]
| Bandwidth | 20 Hz to 21.90 kHz | |
| Fundamental | 28 Hz to 21.90 kHz | <–126 dB |
| | 24 Hz to 28 Hz | <–109 dB |
| | 20 Hz to 24 Hz | <–96 dB |
| Spectrum | | post-FFT of filtered signal |

### Modulation factor (MOD DIST)
| Measurement method | selective to DIN IEC 268-3 |

Frequency range
| Lower frequency | 30 Hz to 2700 Hz[3] |
| Upper frequency | 8 x LF[3] to 21.25 kHz |
| Accuracy | ±0.2 dB |

Inherent distortion[2]
| Level LF:UF | 1:1 | <–133 dB |
| | 4:1 | <–123 dB |
| | 10:1 | <–115 dB |
| Spectrum | | bar chart showing signal and distortion |

### Difference frequency distortion (DFD)
| Measurement method | selective to DIN IEC 268-3 or 118 |

Frequency range
| Difference frequency | 80 Hz to 2 kHz[3] |
| Center frequency | 200 Hz to 20.90 kHz |
| Accuracy | ±0.2 dB |

Inherent distortion[2]
| DFD $d_2$ | <–130 dB |
| DFD $d_3$ | <–130 dB |
| Spectrum | bar chart showing signal and distortion |

### Wow and flutter
| Measurement method | DIN/IEC, NAB, JIS, 2-sigma to IEC-386 |
| Weighting filter OFF | highpass 0.5 Hz, bandwidth 200 Hz |
| ON | bandpass 4 Hz to IEC-386 |
| Accuracy | ±3% |
| Inherent noise | <0.0003% weighted |
| | <0.0008% unweighted |
| Spectrum | post-FFT of demodulated signal |

### Time domain display (WAVEFORM)
| Trigger | rising/falling edge |
| Trigger level | –1 FS to +1 FS, interpolated between samples |
| Trace length | max. 7424 points |
| Standard mode | 1- to 32-fold interpolation |
| Compressed mode | 32- to 1024-fold compression (envelope for AGC measurement) |

### Frequency[4]
| Frequency range | 20 Hz to 20 kHz |
| Accuracy | ±50 ppm |

### Phase[4]
| Frequency range | 20 Hz to 20 kHz |
| Accuracy | ±0.5° |

### Group delay[4]
| Frequency range | 20 Hz to 20 kHz |
| Accuracy in seconds | $\Delta\varphi/(\Delta f \times 360)$, where $\Delta\varphi$ = phase accuracy in °, $\Delta f$ = frequency step |

### Polarity test
| Measurement | polarity of unsymmetrical input signal |
| Display | +POL, –POL |

## Digital generator (option UPL-B2 or -B29)

Frequency limits specified for the signals apply to a sampling rate of 48 kHz. For other sampling rates limits are calculated according to the formula:
$f_{new} = f_{48\,kHz} \times$ sampling rate/48 kHz.

### Outputs
| Balanced output | XLR connector, transformer coupling |
| Impedance | 110 Ω, short-circuit-proof |
| Level ($V_{PP}$ into 110 Ω) | 0 V to 8 V, in 240 steps |
| Accuracy | ±1 dB (rms) |
| Unbalanced output | BNC, transformer coupling |
| Impedance | 75 Ω, short-circuit-proof |
| Level ($V_{PP}$ into 75 Ω) | 0 V to 2 V, in 240 steps |
| Accuracy | ±1 dB (rms) |
| Optical output | TOSLINK |
| Channels | 1, 2 or both |
| Audio bits | 8 to 24 |
| Clock rate | 35 kHz to 55 kHz with UPL-B2 or UPL-B29 in base rate mode |
| | 35 kHz to 106 kHz with UPL-B29 in high rate mode |
| | internal: generator clock or synchronization to analyzer |
| | external: synchronization to word clock input, video sync, DARS, 1024 kHz |
| Format | professional and consumer format to AES3 or IEC-958 as well as user-definable formats at all outputs |

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[1] With UPL-B29 only in base rate mode.
[2] Total inherent distortion of analyzer and generator.
[3] Fixed frequency, independent of sampling rate.

[4] Only for measurement functions RMS, FFT and THD+N, accuracy applies to 8k FFT with zoom factor 2, Rife-Vincent-2 window; S/N ratio >70 dB. Phase and group delay in high rate mode only with RMS without filter.

## Signals

All signals with 24 bits, full scale

### General characteristics

| | |
|---|---|
| Level resolution | $2^{-24}$ |
| Audio bits | 8 to 24 bits, LSB rounded off |
| Dither | for sine, stereo sine, DFD and MOD DIST in high rate mode for sine only |
|     Distribution | Gaussian, triangular, rectangular |
|     Level | $2^{-24}$ FS to 1 FS |
| Frequency accuracy | ±50 ppm (internal clock), ±1 ppm relative to clock rate |
| Frequency offset | for sine, stereo sine, DFD and MOD DIST 0 or +1000 ppm |
| DC offset | 0 to ±1 FS adjustable |

### Sine

| | |
|---|---|
| Frequency range | 2 Hz[1] to 21.90 kHz |
| Total harmonic distortion (THD) | <–133 dB |
| Sweep parameters | frequency, level |

### MOD DIST

for measuring the modulation distortion

| | |
|---|---|
| Frequency range | |
|     Lower frequency | 30[1] to 2700 Hz[1] |
|     Upper frequency | 8 x LF[1] to 21.90 kHz |
| Level ratio (LF:UF) | selectable from 10:1 to 1:1 |
| Inherent distortion[2] | |
|     Level LF:UF  1:1 | <–133 dB |
|              4:1 | <–123 dB |
|             10:1 | <–115 dB |
| Sweep parameters | upper frequency, level |

### DFD

for measuring the difference tone

| | |
|---|---|
| Frequency range | |
|     Difference frequency | 80 Hz to 2 kHz[1] |
|     Center frequency | 200 Hz[1] to 20.90 kHz |
| Inherent distortion[2] | |
|     DFD $d_2$ | <–130 dB |
|     DFD $d_3$ | <–130 dB |
| Sweep parameters | center frequency, level |

### Multi-sine

| | |
|---|---|
| Frequency range | 2.93 Hz to 21.90 kHz |
| Frequency spacing | adjustable from 2.93 Hz |
| Frequency resolution | <0.01% or matching FFT frequency spacing |
| Dynamic range | >133 dB |
| Characteristics | |
|     Mode 1 | 1 to 17 spectral lines |
| | – level and frequency selectable for each line |
| | – phase of each component optimized for minimum crest factor |
| | – phase of each component or crest factor selectable (with UPL-B6) |
|     Mode 2 | 1 to 7400 spectral lines (noise in frequency domain), distribution: white, pink, 1/3 octave, defined by file; crest factor selectable (with UPL-B6) |

### Sine burst, sine² burst

| | |
|---|---|
| Burst time | 1 sample up to 60 s, 1-sample resolution |
| Interval | burst time up to 60 s, 1-sample res. |
| Low level | 0 to burst level, absolute or referred to burst level (0 for sine² burst) |
| Sweep parameters | burst frequency, level time, interval |

### Noise

| | |
|---|---|
| Distribution | Gaussian, triangular, rectangular |

### Arbitrary waveform

loaded from file

| | |
|---|---|
| File format | |
|     *.TTF (internal) | memory depth max. 16 k |
|     *.WAV[3] | reproduction of audio files (mono), duration approx. 10 s per Mbyte RAM |
| Clock rate | sampling rate of generator |

---

[1] Fixed frequency, independent of sampling rate.
[2] Total inherent distortion of analyzer and generator.
[3] With UPL-B29 only in base rate mode.

### Polarity test signal

Sine² burst with following characteristics:

| | |
|---|---|
| Frequency | 1.2 kHz[1] |
| On-time | 1 cycle |
| Interval | 2 cycles |

### FM signal

| | |
|---|---|
| Carrier frequency | 2 Hz[1] to 21.9 kHz |
| Modulation frequency | 1 mHz[1] to 21.9 kHz |
| Modulation | 0% to 100% |

### AM signal

| | |
|---|---|
| Carrier frequency | 2 Hz[1] to 21.9 kHz |
| Modulation frequency | 1 mHz[1] to 21.9 kHz |
| Modulation | 0% to 100% |

### DC voltage

| | |
|---|---|
| Level range | 0 to ±1 FS, can be swept |

## Digital audio protocol (option UPL-B21)

### Generator

| | |
|---|---|
| Validity bit | NONE, L, R, L+R |
| Channel status data | mnemonic entry with user-definable masks, predefined masks for professional and consumer format to AES3 or IEC-958 |
| User data | loaded from file (max. 384 bits) or set to zero |

### Analyzer

| | |
|---|---|
| Display | validity bit L and R |
| Error indication | block errors, sequence errors, clock rate errors, preamble errors |
| Clock rate measurement | 50 ppm |
| Channel status display | user-definable mnemonic display of data fields, predefined settings for professional and consumer format to AES3 or IEC-958, binary and hexadecimal format |
| User bit display | user-definable mnemonic display, block-synchronized |

## Jitter and interface test (option UPL-B22)

### Generator

| | |
|---|---|
| Jitter injection | |
|     Waveform | sine, noise |
|     Frequency range | 10 Hz to 21.75 kHz (sine to 110 kHz with option UPL-B1) |
|     Amplitude (peak-to-peak) | 0 to 5 UI (corresp. to 0 to 800 ns at $f_A$ = 48 kHz) |
| Common mode signal | for balanced output |
|     Waveform | sine |
|     Frequency range | 20 Hz to 21.75 kHz (110 kHz with option UPL-B1) |
|     Amplitude ($V_{PP}$) | 0 V to 20 V |
| Phase (output to reference) | adjustable between –64 and +64 UI (corresp. to ±50% of frame) |
| Cable simulator | 100 m typical audio cable |

### Analyzer

| | |
|---|---|
| Input signal | |
|     Amplitude ($V_{PP}$) | 0 V to 10 V |
|     Clock rate | 35 kHz to 55 kHz with UPL-B2 35 kHz to 106 kHz with UPL-B29 |
| Jitter measurement | amplitude, frequency, spectrum 0 to 5 UI typ. for f <500 Hz, decreasing to 0.5 UI for up to 50 kHz |
|     Measurement limit | 200 ps (noise floor with 8k FFT) |
| Reclocking | input signal sampled with low-jitter clock signal and available at reference output (XLR connector on rear) |
| Common mode test | at balanced input |
|     Amplitude ($V_{PP}$) | 0 V to 30 V |
|     Frequency, spectrum | 20 Hz to 110 kHz |
| Phase (input to reference) | –64 to +64 UI (corresp. to ±50% of frame) |
| Delay (input to output) | 100 µs to 500 ms |

# FFT analyzer

Frequency range
| | |
|---|---|
| Digital 48/96 kHz | DC to 21.9/43.8 kHz |
| ANLG 22/110 kHz | DC to 21.9/110 kHz |

Dynamic range
| | |
|---|---|
| Digital | >135 dB |
| ANLG 22 kHz | 120 dB/105 dB[1] |
| ANLG 110 kHz | 115 dB/85 dB[1] |

Noise floor
| | |
|---|---|
| Digital | –160 dB |
| ANLG 22 kHz | –140 dB/110 dB[1] |
| ANLG 110 kHz | –120 dB/90 dB[1] |
| FFT size | 256, 512, 1k, 2k, 4k, 8k points (16k with zoom factor 2) |
| Window functions | rectangular, Hann, Blackman-Harris, Rife-Vincent 1-3, Hamming, flat top, Kaiser (ß = 1 to 20) |
| Resolution | from 0.05 Hz with zoom, from 5.86 Hz without zoom |
| Zoom | 2 to 128 (2 to 16 mit ANLG 110) |
| Averaging | 1 to 256, exponential or normal |
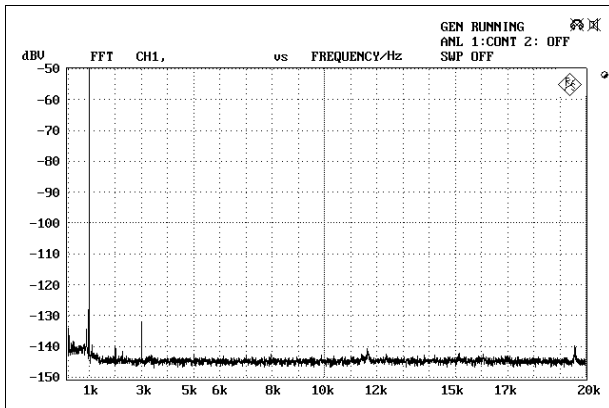


Typical noise floor of FFT analysis at analog inputs

# Filter

For all analog and digital analyzers. Up to 3 filters can be combined as required. All filters are digital filters with a coefficient accuracy of 32 bit floating point (exception: analog notch filter).

**Weighting filters**
- A weighting
- C message
- CCITT
- CCIR weighted, unweighted
- CCIR ARM
- deemphasis 50/15, 50, 75, J.17
- rumble weighted, unweighted
- DC noise highpass
- IEC tuner
- jitter weighted

---

[1] With/without analog notch filter.

## User-definable filters

8th order elliptical, type C (for highpass and lowpass filters also 4th order), passband ripple +0/–0.1 dB, stopband attenuation approx. 20 dB to 120 dB selectable in steps of approx. 10 dB (highpass and lowpass filters: stopband attenuation 40 to 120 dB).

| | |
|---|---|
| Highpass, lowpass filters | limit frequencies (–0.1 dB) selectable, stopband indicated |
| Bandpass, bandstop filters | passband (–0.1 dB) selectable, stopband indicated |
| Notch filter | center frequency and width (–0.1 dB) selectable, stopband indicated |
| Third octave and octave filters | center frequency selectable, bandwidth (–0.1 dB) indicated |
| File-defined filters | any 8th order filter cascaded from 4 biquads, defined in the z plane by poles/zeroes or coefficients |

## Analog notch filter

For measurements on signals with high S/N ratio, this filter improves the dynamic range of the analyzer by up to 30 dB to 140 dB for analyzer 22 kHz, or 120 dB for analyzer 110 kHz (typical noise floor of FFT). The filter is also used for measuring THD, THD+N and MOD DIST with dynamic mode precision.

| | |
|---|---|
| Characteristics | available in analog analyzers with measurement functions: <br> – rms, wideband <br> – rms, selective <br> – quasi-peak <br> – FFT analysis |
| Frequency range | 10 Hz to 22.5 kHz center frequency ($f_c$) |
| Frequency tuning | – automatic to input signal <br> – coupled to generator <br> – fixed through entered value |
| Stopband | typ. >30 dB, $f_c$ ±0.5% |
| Passband | typ. –3 dB at 0.77 x $f_c$ and 1.3 x $f_c$, typ. +0/–1 dB outside 0.5 x $f_c$ to 2 x $f_c$ |

# Sweep

**Generator sweep**
| | |
|---|---|
| Parameters | frequency, level, with bursts also interval and duration, one- or two-dimensional |
| Sweep | linear, logarithmic, tabular, single, continuous, manual |
| Stepping | – automatic after end of measurement <br> – time delay (fixed or loaded table) |

**Analyzer sweep**
| | |
|---|---|
| Parameters | frequency or level of input signal |
| Sweep | single, continuous |
| Trigger | – delayed (0 to 10 s) after input level or input frequency variation, settling function selectable <br> – time-controlled |
| Settling | for level, frequency, phase, distortion measurements, settling function: exponential, flat or averaging |

**Sweep speed**

Two-channel rms measurement 20 Hz to 20 kHz, 30-point generator sweep logarithmic (frequency measurement switched off, Low Dist off).
| with | | |
|---|---|---|
| | GEN TRACK | 0.5 s |
| | AUTO FAST | 1 s |
| | AUTO | 2.5 s |

## Display of results

**Units**

| | |
|---|---|
| Level (analog) | V, dBu, dBV, W, dBm, difference (Δ), deviation (Δ%) and ratio (without dimension, %, dBr) to reference value |
| Level (digital) | FS, %FS, dBFS, LSBs deviation (Δ%) or ratio (dBr) to reference value |
| Distortion | % or dB, referred to signal amplitude, THD and THD+N in all available level units (absolute or relative to selectable reference value) |
| Frequency | Hz, difference (Δ), deviation (Δ%) and ratio (as quotient $f/f_{ref}$, 1/3 octave, octave or decade) to reference value (entered or stored, current generator frequency) |
| Phase | °, rad, difference (Δ) to reference value (entered or stored) |

Reference value (level):
Fixed value (entered or stored).
Current value of a channel or generator signal: permits direct measurement of gain, linearity, channel difference, crosstalk. In sweep mode, traces (other trace or loaded from file) can be used as a reference too.

**Graphical display of results**

| | |
|---|---|
| Monitor (not UPL66) | 8.4" LCD, colour |
| Display modes | – display of any sweep trace<br>– display of trace groups<br>– bargraph display with min./max. values<br>– spectrum, also as waterfall display<br>– list of results<br>– bar charts for THD and intermodulation measurements |
| Display functions | – autoscale<br>– X-axis zoom<br>– full-screen and part-screen mode<br>– 2 vertical,1 horizontal cursor line<br>– search function for max. values<br>– marker for harmonics (spectrum)<br>– user-labelling for graphs<br>– change of unit and scale also possible for loaded traces |

**Test reports**

| | |
|---|---|
| Functions | – screen copy to printer, plotter or file (PCX, HPGL, Postscript)<br>– lists of results<br>– sweep lists<br>– tolerance curves<br>– list of out-of-tolerance values<br>– equalizer traces |
| Printer driver | supplied for approx. 130 printers |
| Plotter language | HP-GL |
| Interfaces | 2 x RS-232-C, Centronics, IEC 625 (option UPL-B4) |

| | |
|---|---|
| **Storage functions** | – instrument settings, optionally with measured values and curves<br>– spectra<br>– sweep results<br>– sweep lists<br>– tolerance curves<br>– equalizer traces |

| | |
|---|---|
| **Remote control** | via IEC 625-2 (IEEE 488) and RS-232; commands largely to SCPI (option UPL-B4) |

## Audio monitor (option UPL-B5)

| | |
|---|---|
| **Headphones connector** | 6.3 mm jack |
| Output voltage ($U_P$) | max. 8 V |
| Output current ($I_P$) | max. 50 mA |
| Source impedance | 10 Ω, short-circuit-proof |
| Recommended headphone impedance | 600 Ω |

## Extended analysis functions (option UPL-B6)

| | |
|---|---|
| **Coherence and transfer functions** | can be displayed simultaneously |
| Frequency range | DC to 21.9 kHz |
| Frequency resolution | from 5.86 Hz |
| Averaging | 2 to 2048 |
| FFT length | 256, 512, 1k, 2k, 4k, 8k points |
| **Rub & buzz measurement** | simultaneous measurement of frequency response, rub & buzz and polarity[1] |
| Frequency range | 10 Hz to 110 kHz |
| Tracking highpass filter | 2 to 20 times fundamental |
| Lower/upper frequency limit | selectable |
| Measurement time (200 Hz to 20 kHz, 200 points log.) | 2 s |
| **Multi-sine generator function** | extended functions |
| Mode 1 | crest factor or phase of each component selectable |
| Mode 2 | crest factor selectable |
| **Third octave analysis** | for analyzer ANLG 22 kHz and digital 48 kHz |
| Number of third octaves | 30 |
| Frequency range | 22 Hz to 22 kHz |
| Level accuracy | |
| Center frequency | ±0.2 dB |
| 22 Hz to 22 kHz | ±1.0 dB (IEC 1260, class 0) |
| **Stereo sine** | in digital generator only |
| Frequency range | 2 Hz[2] to 21.9 kHz |
| Frequency | adjustable for each channel |
| Phase | 0 to 360° (same frequency in both channels) |
| Level | adjustable for each channel or channel ratio 2/1 |
| Sweep parameters | frequency and level of channel 1 |
| **Other functions** | under development |

## Hearing aids test accessories (option UPL-B7)

Consisting of acoustic test chamber, acoustic 2 cm³ coupler, various battery adapters, connecting cables, software for measurements to IEC60118 and ANSI S3.22

| | |
|---|---|
| Additionally required | options UPL-B5 and UPL-B10 |

## Modification UPL-U3

Change of source impedance of analog generator to 150 Ω (instead of 200 Ω set as standard) at the factory

[1]   With UPL-B29 only in base rate mode.
[2]   Fixed frequency independent of clock rate.

## General data

| | |
|---|---|
| Operating temperature range | 0 °C to +45 °C |
| Storage temperature range | –20 °C to +60 °C |
| Humidity | max. 85% for max. 60 days, below 65% on average/year, no condensation |
| EMI | EN 50081-1 |
| EMS | EN 50082-1 |
| Safety standards | DIN EN 61010-1, IEC 1010-1, UL 3111-1, CAN/CSA C 22.2 No. 1010-1 |
| Conformity marks | VDE-GS, UL, cUL |
| Power supply | 100/120/220/230 V ±10%, 50 Hz to 60 Hz, 160 VA |
| Dimensions (W x H x D) | 435 mm x 192 mm x 475 mm |
| Weight | 12.6 kg |

## Ordering information

**Order designation**

| | | |
|---|---|---|
| Audio Analyzer | UPL | 1078.2008.06 |
| Audio Analyzer (for conformance tests on GSM mobile phones) | UPL16 | 1078.2008.16 |
| Audio Analyzer (without display and keypad) | UPL66 | 1078.2008.66 |

**Accessories supplied**  power cable, operating manual, back-up system disks with MS-DOS operating system and user manual, backup program disk with operating and measurement software

**Options**

| | | |
|---|---|---|
| Low Distortion Generator | UPL-B1 | 1078.4400.02 |
| Digital Audio I/O 48 kHz | UPL-B2 | 1078.4000.02 |
| Digital Audio I/O 96 kHz | UPL-B29 | 1078.5107.02 |
| Digital Audio Protocol | UPL-B21 | 1078.3856.02 |
| Jitter and Interface Test | UPL-B22 | 1078.3956.02 |
| Remote Control | UPL-B4 | 1078.3804.02 |
| Audio Monitor | UPL-B5 | 1078.4600.03 |
| Extended Analysis Functions | UPL-B6 | 1078.4500.02 |
| Hearing Aids Test Accessories | UPL-B7 | 1090.2704.02 |
| Mobile Phone Test Set | UPL-B8 | 1117.3505.02 |
| Universal Sequence Controller | UPL-B10 | 1078.3904.02 |
| Line Measurement to ITU-T O.33 | UPL-B33 | 1078.4852.02 |
| XLR/BNC Adapter Set | UPL-Z1 | 1078.3704.02 |
| 150 Ω Modification | UPL-U3 | 1078.4900.02 |

**Recommended extras**

| | | |
|---|---|---|
| 19" Rack Adapter | ZZA-94 | 0396.4905.00 |
| Service manual | | 1078.2089.24 |