ROHDE&SCHWARZ

Test and Measurement
Division

Service Manual

AUDIO ANALYZER

UPL

10 Hz to 110 kHz

1078.2008.02/05

Printed in the Federal
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Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

ROHDE & SCHWARZ

095.1000 Bl.0-0796

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Explanation of Symbols Used

- Read operating manual, observe the safety symbols used

- Caution, shock hazard

- Protective ground connection

- Unit ground

-Equipotentiality

- Ground

EMC Recommendations

The electromagnetic compatibility of the UPl complies with the relevant standards specified in the data sheet.
Please observe the following to obtain accurate measurements in the presence of electromagnetic disturbances:

- Use shielded cables to all connectors of the UPL (both measurement inputs/outputs and computer links to eg the printer).
- The balanced inputs/outputs are much less susceptible to interference fields than the unbalanced ones and should therefore be used in the relevant cases.
- For connection of an external monitor, we recommend the use of a low-radiation model.
- When operating the UPD with an external keyboard, the Rohde & Schwarz keyboard which is protected against radiated noise should be employed.

ESD Recommendations

The unit cannot offer absolute protection against electrostatic discharge at the generator and test connectors due to critical parameters such as high input sensitivity, low intrinsic distortion, high unbalance rejection and also because of the floating generator and test inputs. The unit is ressistant to ESD up to approx. ± 4 kV. In sensitive environments, eg highly isolating floor coverings or clothing and shoes of operators, it is recommended to take the relevant ESD protective measures before contacting the floating built-in connectors.

Safety Instructions

This unit has been designed and tested according to the standards outlined overleaf and has left the manufacturer's premises in a state fully complying with the safety standards.

In order to maintain this state and to ensure safe operation, observe the following instructions, symbols and precautions.

1) When the unit is to be permanently cabled, first connect protective ground conductor before making any other connections.

2) Built-in units should only be operated when properly fitted into the system.

3) For permanently cabled units without built-in fuses, automatic switches or similar protective facilities, the AC supply line shall be fitted with fuses rated to the units.

4) Before switching on the unit ensure that the operating voltage set at the unit matches the line voltage.

   If a different operating voltage is to be set, use a fuse with appropriate rating.

5) Units of protection class I with disconnectible AC supply cable and plug may only be operated from power socket with protective ground contact.

   The protective ground connection should not be made ineffective by an extension cable.

   Any breaking of the protective ground conductor within or outside of the unit or loosening of the protective ground connection may cause the unit to become electrically hazardous.
   The protective ground conductor shall not be interrupted intentionally.

6) Before opening the unit, isolate it from the AC supply.

   Adjustment and replacement of parts as well as maintenance and repair should be carried out only by specialists approved by R & S.

   Observe safety regulations and rules for the prevention of accidents.

   Use only original parts for replacing parts relevant to safety (e.g. power on/off switches, power transformers or fuses).

7) Also observe the additional safety instructions specified in this manual.

UPL Service Manual VOLUME 1

Contents

UPL Service Manual VOLUME 2
Contents

Circuit Diagrams / Component Plans / XY Lists / Parts Lists
Interface Descriptions

All modules not listed above are no R&S developments but parts from subsuppliers.

As the individual manufacturers do not provide documents such as circuit diagrams or parts lists, repair down to component level is not possible.
In the case of complaint, the complete module has to be replaced.
The module can be bought via the appropriate R&S representative or directly via R&S, Zentralservice München.

A list of the spare parts and replacement parts is contained in VOLUME 1 of the Service Manual. The relevant Order Nos. can be found in the Parts List of the UPL (1078.2008.01 SA) in VOLUME 2, Register 1.

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Supplement to Service Manual UPL

The order no. 0633.8289.00 on pages 2.7 and 2.8 is wrong.
The correct number is 0633.2889.00.

Between sections 2.1 and 2.2 the following section is missing:

Measurement Uncertainty

In the Performance Test Report, the specifications of the data sheet are used as limit values in the columns 'MIN' und 'MAX'. The units of the measured values are selected such that the measurements can be performed as easily as possible without having to convert the results to %, dB or other relative units as they are used in the data sheet.
The evaluation of the test results in the test report must take into account the measurement uncertainty of the test setup used. As soon as the difference between test value and limit value becomes smaller than the measurement uncertainty, the probability that the instrument can no longer ensure data integrity increases very much. When the test value has reached the limit value, the probability of the instrument ensuring data integrity is only 50 % at this test point.
In this case, try to improve the measurement result by carrying out an adjustment. Which test points can be affected by which adjustments is indicated in the test instruction.
If a test is carried out in the factory, the instrument is only regarded as error-free if the difference between all test values and the respective limit value exceeds the measurement uncertainty.

The versions UPL06 and UPL66 are identical to the versions UPL02 and UPL05, except the following changes:

UPL06: The motherboard (PC mainboard, module A7) is replaced with a PC board with socket 7. This requires a software version 1.19 or higher. Additionally the shielding inside the unit has been improved.
The new motherboard consists of following parts:

A7	Motherboard	1078.3556.00	
D7	CPU	1078.3562.00	
	CPU Fan	1078.3579.00	
A70	Memory	0010.9500.00	(two pieces required)

UPL66: Same as UPL06, but without the complete front panel unit 1078.2308.05 module A20). Instead a front panel unit without LCD and keyboard is installed.
The new front panel unit consists of following parts:

Mounting panel	1078.2372.00
Distance piece	1078.2389.00
Front panel	1078.2520.00
Option cover	1078.2437.00
LED board	1078.2850.02

If the Option UPL-U3 (Generator output impedance 150Ω instead of 200Ω) is installed:
In the performance test, on page 2.65, check for 150Ω ± 0.75Ω instead of 200Ω ± 1Ω.

ROHDE&SCHWARZ

Schlüsselliste für Bauteile-Sachnummern

Code list for component stock Nos.

Liste des références des composants

(R 29500 Bl 5)
095.1000 Bl. 5

ROHDE&SCHWARZ

R&S-Schlüsselliste
R&S key list
Liste des symboles de référence R&S

Die R&S-Schaltteillisten nennen in der Spalte "Benennung/Beschreibung" die technischen Daten der Bauelemente in Kurzform. Die Art des Bauelements (z.B. Schicht-, Draht-Widerstand usw.) beschreiben die 2 Kennbuchstaben vor der "Benennung" (evtl. auch vor der "Sachnummer"), die nachfolgend erklärt werden. In Ersatzteil-Bestellungen an R&S ist stets die Angabe der vollständigen Sachnummer erforderlich.

The R&S Parts Lists give the technical data of the components in short form in the column "Benennung/Beschreibung" (designation). The type of component (e.g. depos.-carbon resistor, wire-wound resistor etc.) is indicated by 2 identification letters before the designation, possibly also before the "Sachnummer" (order number), which are explained below. When ordering spare parts from R&S, the complete order number must always be specified.

La colonne «Désignation/description» des listes de pièces de R&S indique les caractéristiques des éléments sous forme abrégée. Le type d'élément (p. ex. résistance à couche, résistance bobinée etc. . . .) est décrit par les deux lettres précédant la désignation (et éventuellement le numéro de référence), dont voici l'explication. Prière d'indiquer le numéro de référence («Sachnummer») complet dans toute commande de pièces de rechange.

Teilefamilie	Art des Bauelementes	Parts family	Type of component	Famille	Type d'element
A	**Aktive Bauelemente, Halbleiter**	**A**	**Active components, semiconductors**	**A**	**Composants actifs, semiconducteurs**
AD	Universaldiode, z.B. Gleichrichter, Sperrdiode	AD	General-purpose diode, e.g. rectifier, high-resistance diode	AD	Diode d'usage général, p.ex. redresseur, diode à haute résistance
AE	Spezialdiode, z.B. Tunnel-, Kapazitäts-, Zener-Diode	AE	Diode (special), e.g. tunnel diode, varactor, Zener diode	AE	Diode spéciale, p.ex. diode tunnel, varactor, diode Zener
AF	Fotohalbleiter, z.B. Foto-Diode, -Transistor, -Widerstand, Leuchtdiode	AF	Photo-semiconductor, e.g. resistor, diode, transistor, LED	AF	Semiconducteur photoélectrique, p.ex. diode, transistor, résistance photoél., DEL
AG	Leistungs-Gleichrichter, z.B. Thyristor, Triac, Selengleichrichter	AG	Power rectifier, e.g. thyristor, triac, selenium rectifier	AG	Redresseur de puissance, p.ex. thyristor, triac, redresseur, au sélénium
AK	Kleinsignal-Transistor	AK	Small-signal transistor	AK	Transistor faible puissance
AL	Leistungs-Transistor	AL	High-power transistor	AL	Transistor grande puissance
AM	Spezial-Transistor, z.B. FET, MOSFET	AM	Transistor (special), e.g. FET, MOS-FET	AM	Transistor spécial, p.ex. TEC, MOSTEC
AP	Peltier-, Hall-Element	AP	Peltier element, Hall element	AP	Element Peltier, élement Hall
AR	Röhre für Empfänger, Verstarker, Gleichrichter	AR	Valve for receiver, amplifier, rectifier	AR	Tube pour récepteur, amplificateur, redresseur
AS	Spezialröhre, z.B. Senderöhre, EW-Widerstand, Stabilisator	AS	Valve (special), e.g. for transmitter, barretter, ballast valve	AS	Tube (spécial), p.ex. pour émetteur, résistance fer-hydrogène, ballast
AT	Katodenstrahlröhre, z.B Bildröhre, Ziffern-Anzeigeröhre	AT	Cathode ray tube, e.g. picture tube, digital indicator tube	AT	Tube à rayon cathodique, p.ex. tube à image, tube à affichage numérique
AZ	Zubehör für Halbleiter u. Röhren	AZ	Accessories for semiconductors and valves	AZ	Accessoires pour semiconducteurs et tubes
B	**Bausteine**	**B**	**PC boards, chips**	**B**	**Cartes imprimées, puces**
BC	Integr. Schaltkreis (Microcomp.)	BC	Integrated circuit (interface, A/D)	BC	Circuit intégré (microprocesseur)
BD	R&S-Dünnschicht- und Dickschicht-schaltung	BD	R&S thinfilm or thickfilm circuit	BD	Circuit R&S à couche mince ou épaisse
BG	R&S-spezifische Gate-Arrays	BG	R&S gate arrays	BG	Circuits intégrés prédiffusés R&S
BJ	Integrierter Schaltkreis (Interface, A/D-Wandler)	BJ	Integrated circuit (interface, A/D converter)	BJ	Circuit intégré (interface, convertisseur A/N)
BL	Log. Schaltkreis z.B. DTL, TTL, HTL, ECL, C-MOS	BL	Logic circuit, e.g. DTL, TTL, HTL, ECL, C-MOS	BL	Circuit logique, p.ex. DTL, TTL, HTL, ECL, C-MOS
BM	Hybridbaustein, z.B. Mischer, Tuner, Modulator	BM	Hybrid chip, e.g. mixer, tuner, modulator	BM	Puce hybride, p.ex. mélangeur, tuner, modulateur
BO	Analogschaltkreis, z.B. Operationsverstärker	BO	Analog circuit, e.g. operational amplifier	BO	Circuit analogique, p.ex. amplificateur opérationnel
BP	Optoelektronischer Baustein, z B Anzeigeeinheit, Koppler	BP	Optoelectronic component, e.g. display, coupler	BP	Composant optoélectronique, p.ex. afficheur, coupleur
BS	Schalt- und Steuerbaustein, elektronischer Sensor	BS	Switching and control modul, electronic sensor	BS	Modul de commutation et de commande, sonde electronique
BV	Stromversorgung, Übersp.-Schutz	BV	Power pack, protective circuit	BV	Alimentation, protection surcharge
BZ	Zubehör	BZ	Accessories	BZ	Accessoires

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famille	Type d'element
C	**Kondensatoren**	**C**	**Capacitors**	**C**	**Condensateurs**
CB	Bypass-, Durchf.-Kondensator	CB	Bypass capacitor, feed-through capacitor	CB	Condensateur bypass, condensateur de traversée
CC	Keramischer Kondensator	CC	Ceramic capacitor	CC	Condensateur céramique
CD	Drehkondensator	CD	Variable capacitor	CD	Condensateur variable
CE	Elektrolytkondensator	CE	Electrolytic capacitor	CE	Condensateur électrolytique
CG	Glimmerkondensator	CG	Mica capacitor	CG	Condensateur au mica
CH	Sperrschichtkondensator	CH	Semiconductor capacitor	CH	Condensateur semiconducteur
CK	Kunstfolienkondensator	CK	Synthetic-foil capacitor	CK	Condensateur à feuille synthétique
CL	Ker. Hochsp.-Kondensator	CL	HV capacitor (ceramic)	CL	Condensateur HT céramique
CM	Metallpapier-Kondensator	CM	MP capacitor	CM	Condensateur à papier métallisé
CN	Kondensatornetzwerk	CN	Capacitor network	CN	Réseau capacitif
CP	Papierkondensator	CP	Paper capacitor	CP	Condensateur au papier
CS	Störschutzkondensator	CS	Interference-suppression capacitor	CS	Condensateur anti-parasite
CT	Trimmkondensator	CT	Trimmer capacitor	CT	Condensateur ajustable
CV	Vakuum-Kondensator	CV	Vacuum capacitor	CV	Condensateur à vide
D	**Drähte, Leitungen**	**D**	**Wires, lines**	**D**	**Fils, lignes**
DD	Schalt- und Wickeldraht	DD	Hook-up or winding wire	DD	Fil de câblage, fil de bobinage
DF	Flachleitung, Litze	DF	Flat multiple line, stranded wire	DF	Ligne plate, ligne torsadée
DG	Abgeschirmte Leitung	DG	Shielded line	DG	Ligne blindé
DH	Koaxialkabel	DH	Coaxial line	DH	Ligne coaxiale
DJ	Isolierschläuche, Schrumpfschläuche, Wellrohre, Schutzschläuche	DJ	Insulating sheaths, shrink-on sleeves, corrugated tubes, protective tubes	DJ	Gaines isolantes, gaines thermorétractables tubes ondulés, gaines protectrices
DL	HF-Litzen	DL	RF stranded wires	DL	Lignes torsadées RF
DM	Schaltlitzen (mehrdrähtige Leiter)	DM	Multi-conductor wires	DM	Lignes torsadées (multiconducteurs)
DN	Antenne	DN	Antenna	DN	Antenne
DO	Lichtleiter (optisch)	DO	Optical waveguides	DO	Guides d'onde optiques
DP	Leiterplatten (unbestückt)	DP	Printed circuit boards (bare)	DP	Cartes imprimées (non équipées)
DQ	Multilayer (unbestückt)	DQ	Multilayer boards (bare)	DQ	Cartes multicouche (non équipées)
DS	Anschlußkabel (mehradrig)	DS	Connecting cable, multicore	DS	Câble de connexion (multiconducteur)
DU	Substratplatten für Dickschichtschaltungen	DU	Substrate boards for thickfilm circuits	DU	Cartes à substrat pour circuits à couche épaisse
DW	Festmantelkabel	DW	Rigid cables	DW	Câbles rigides
E	**Elektrische Teile**	**E**	**Electric parts**	**E**	**Organes électriques**
EB	Blei-, NC-Akku, Batterie	EB	Lead or alkaline accumulator, battery	EB	Accumulateur Pb/NC, batterie
ED	Gedruckte Schaltung (bestückte Leiterplatte), nicht steckbar	ED	Printed circuits (assembled), non-pluggable	ED	Circuits imprimés (équipés) non enfichables
EE	Gedruckte Schaltung (bestückte Leiterplatte), steckbar	EE	Printed circuits (assembled), pluggable	EE	Circuits imprimés (équipés) enfichables
EF	Glühlampe, Leuchte	EF	Incandescent lamp, pilot lamp	EF	Lampe à incandescence, voyant
EG	Glimmlampe, Entladungslampe	EG	Glow lamp, discharge lamp	EG	Lampe à luminescence lampe à décharge
EK	Kontakt-Streifen, -Feder	EK	Contact clip, contact spring	EK	Lampe de contact, ressort de contact
EL	Lautsprecher, Kopfhörer, Mikrofon	EL	Loudspeaker, headphones, microphone	EL	Haut-parleur, casque, microphone
EM	Motor, Hubmagnet, Drehfeldsystem	EM	Motor, lifting magnet, synchro system	EM	Moteur, électro-aimant de levage, système synchro
EO	Oszillator, z.B. Quarzoszillator	EO	Oscillator, e.g. crystal oscillator	EO	Oscillateur p.ex. oscillateur à quartz
EP	Tief-, Band-, Hochpaß, Bandsperre, Diskriminator	EP	Lowpass, bandpass, highpass filter, band-stop filter, discriminator	EP	Filtre passe-bas, passe-bande, passe-haut, suppression de bande, discriminateur
EQ	Schwing-, Filter-Quarz	EQ	Oscillator or filter crystal	EQ	Quartz oscillateur, quartz de filtre
ER	Resonator, piezoelektr./magnetostriktiv	ER	Resonator, piezoelectric/ magnetostrictive	ER	Résonateur piézo-électrique/ magneto-strictif
ES	Passive SHF-Bauteile	ES	Passive SHF-components	ES	Composant SHF passif
ET	Thermostat	ET	Thermostat	ET	Thermostat
EV	Lüfter, Gebläse	EV	Ventilator, blower	EV	Ventilateur, soufflerie

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famil-le	Type d'element
F	**Fassungen, Steckverbindungen**	**F**	**Sockets, connectors**	**F**	**Douilles, connecteurs**
FG	Koax-Umrüstsatz	FG	Coaxial screw-in assembly	FG	Ensemble vissable coaxial
FH	Koax-Übergang auf Fremdsystem	FH	Coaxial adapter	FH	Adaptateur coaxial
FJ	BNC-Systemteil	FJ	BNC screw-in assembly	FJ	Ensemble vissable BNC
FK	Koaxial-UHF-Systemteil	FK	Coaxial UHF screw-in assembly	FK	Ensemble vissable coaxial UHF
FM	Mehrfachstecker, Buchsenleiste	FM	Multipoint connector	FM	Connecteur multiple
FN	Netz-Steckverbindung	FN	AC-supply connector	FN	Connecteur secteur
FO	Runde Mehrfach-Steckverbindung	FO	Round multipoint connector	FO	Connecteur multipoles rond
FP	Druckschalt-Steckverbindung	FP	Multipoint connector for PC boards	FP	Connecteur multipoles pour cartes imprimées
FR	Fassung für Lampe, Sicherung, usw.	FR	Socket for lamp, fuse, etc.	FR	Douille pour lampe, fusible etc. . . .
FT	Schwachstrom-Steckverbindung	FT	LV plug and socket	FT	Connecteur pour faible courant
FU	Hochspannungs-Steckverbindung	FU	HV plug and socket	FU	Connecteur pour haute tension
FV	Verbinder (z.B. AMP)	FV	Push-on connector	FV	Connecteur à enfichage
FZ	Zubehör für koax. Bauelemente	FZ	Accessories for coax. components	FZ	Accessoires pour composants coax.
H	**Software**	**H**	**Software**	**H**	**Logiciel**
HP	Software-Komponenten und Software-Module	HP	Rights to software components and software modules	HP	Droits d'utilisation de composants et modules logiciel
HS	Auf Informationsträger geladene Software	HS	Software data media	HS	Logiciel sur support d'information
J	**Meßinstrumente**	**J**	**Indicators**	**J**	**Indicateurs**
JD	Drehspul-Anzeigeinstrument	JD	Moving-coil meter	JD	Galvanomètre à cadre mobile
JE	Dreheisen-Anzeigeinstrument	JE	Moving-iron meter	JE	Galvanomètre à fer mobile
JF	Frequenzmesser	JF	Frequency meter	JF	Fréquencemètre
JG	Drehspulinstrument mit Gleichrichter	JG	Moving-coil meter with rectifier	JG	Galvanomètre à cadre mobile avec redresseur
JH	Betriebsstundenzähler	JH	Operating-hours counter	JH	Compteur d'heures de fonctionnement
JJ	Impulszähler	JJ	Pulse counter	JJ	Compteur d'impulsions
JK	Kleinst-Instrument, z.B. Abstimmanzeiger	JK	Mini-instrument, e.g. tuning indicator	JK	Petit indicateur, p.ex. indicateur d'accord
JM	Mechanisches Zählwerk	JM	Mechanical counter	JM	Compteur mécanique
JP	Projektions-Instrument (Leuchtziffer)	JP	Digital display	JP	Afficheur numérique
JQ	Quotientenmesser (Kreuzspulinstrum.)	JQ	Ratiometer (cross coul)	JQ	Quotientmètre (à cadres croisés)
JU	Uhrwerk	JU	Clockwork	JU	Mouvement d'horlogerie
JW	Elektrodyn. Anzeigeinstrument	JW	Electrodynamic meter	JW	Instrument électrodynamique
L	**Induktivitäten, Magnetik**	**L**	**Inductors, magnetic components**	**L**	**Composants inductifs et magnétiques**
LB	Blech- und Schnittbandkern mit Zubehör	LB	Laminated and C-cores with accessories	LB	Noyaux feuilletés et noyaux de type C, avec accessoires
LC	Keramische Spule	LC	Ceramic coil	LC	Bobine céramique
LD	Netz-, HF-Drossel, Df-Filter	LD	Choke, lead-through filter	LD	Self de choc, filtre dè traversée
LE	Einzelkreis, Bandfilter	LE	Single tuned circuit, bandpass filter	LE	Circuit accordé, filtre passe-bande
LF	Ferritkern mit Zubehör	LF	Ferrite cores with accessories	LF	Noyaux en ferrite avec accessoires
LK	Karbonyleisenkern und elektrischer Kupferkern mit Zubehör	LK	Iron carbonyl slugs and copper slugs with accessories	LK	Noyaux en fer carbonyle et en cuivre, avec accessoires
LL	Luftspule	LL	Air-core coils	LL	Bobines à air
LM	Magnetband und -platte	LM	Magnetic tapes and disks	LM	Bandes et disques magnétiques
LS	Schirmbecher	LS	Screening cans	LS	Boîtiers de blindage
LT	Netztransformator	LT	Power transformer	LT	Transformateur secteur
LU	NF-Übertrager	LU	AF transformer	LU	Transformateur BF
LV	Variometer	LV	Variometer	LV	Variomètre
LW	Wickelkörper, allgemein	LW	Coil formers, general	LW	Carcasses de bobine, en général

Teile-familie	Art des Bauelementes	Parts family	Type of component	Famil-le	Type d'élément
R	**Widerstände**	**R**	**Resistors**	**R**	**Résistances**
RD	Drahtwiderstand	RD	Wire-wound resistor	RD	Résistance bobinée
RF	Kohleschicht-Widerstand	RF	Carbon-film resistor	RF	Résistance à couche de carbone
RG	Metallglasur-Widerstand	RG	Metal-coated resistor	RG	Résistance à couche métallique
RJ	Metalloxyd-Widerstand	RJ	Metal-oxide resistor	RJ	Résistance à oxyde métallique
RK	Kaltleiter, Heißleiter, Varistor	RK	PTC, NTC resistors, varistors	RK	Résistances CPT, CNT, varistors
RL	Metallfilm-Widerstand	RL	Metal-film resistor	RL	Résistance à film métallique
RN	Widerstandsnetzwerk	RN	Resistor network	RN	Réseau de résistance
RR	Draht-Potentiometer	RR	Wire-wound potentiometer	RR	Potentiomètre bobiné
RS	Schicht-Potentiometer	RS	Carbon-film potentiometer	RS	Potentiomètre à couche
RT	Dämpfungsglied, Abschlußwiderstand	RT	Attenuator, termination	RT	Atténuateur, charge
RV	Drahtwiderstand mit Abgriff	RV	Wire-wound resistor, tapped	RV	Résistance bobinée à prise
RW	Wendelpotentiometer	RW	Helical potentiometer	RW	Potentiomètre hélicoidal
S	**Schalter, Relais, Sicherungen**	**S**	**Switches, relays, fuses**	**S**	**Commutateurs, relais, fusibles**
SB	Drucktastenschalter	SB	Pushbutton switch	SB	Commutateur à touche
SD	Drehschalter	SD	Rotary switch	SD	Commutateur rotatif
SF	Kontaktfedersatz	SF	Spring contact assembly	SF	Jeu de ressorts de contact
SH	HF-Koaxialschalter, -Relais, -Teiler	SH	Coaxial RF switch, RF relay, RF attenuator	SH	Commutateur RF coaxial, relais RF, atténuateur RF
SK	Kipp-, Wipp- und Schiebeschalter	SK	Toggle switch, slide switch	SK	Commutateur à bascule, à glissière
SL	Leistungsschalter Netz/HF	SL	AC supply switch, high-power RF switch	SL	Commutateur secteur, de puissance RF
SM	Mikroschalter	SM	Microswitch	SM	Microrupteur
SN	Elektromagnet, Relais	SN	Electromagnetic relay	SN	Relais électromagnétique
SP	Leistungsrelais, Luftschütz	SP	Power relay, air-type contactor	SP	Relais de puissance, contacteur à air
SR	Reedrelais	SR	Reed relay	SR	Relais reed
SS	Sicherung, Schutzschalter	SS	Fuse, automatic cut-out	SS	Fusible, coupe-circuit automatique
ST	Thermoschalter	ST	Thermal circuit breaker	ST	Disjoncteur thermique
SU	Überspannungs-Ableiter	SU	Arrester	SU	Eclateur
SW	Wechselrichter, Näherungsschalter	SW	Inverter (DC-AC), proximity switch	SW	Inverseur (DC-AC), commutateur de proximité
SZ	Zeitschalter	SZ	Time switch	SZ	Interrupteur horaire
V	**Verbindungselemente**	**V**	**Connecting elements**	**V**	**Eléments de raccordement**
VK	Klemme, Klemmleiste	VK	Clamp, terminal strip	VK	Pince, réglette à bornes
VL	Lötöse, Stützpunkt	VL	Soldering lug	VL	Cosse à souder
VS	Schraube, Mutter, Scheibe	VS	Screw, nut, washer	VS	Vis, écrou, disque

Farbcode für Widerstände und Kondensatoren

Anmerkung:
Die Wertangabe der weitgehend miniaturisierten Bauelemente erfolgt überwiegend durch Farbkennzeichnungen, deren Bedeutung der nachfolgenden Tabelle entnommen werden kann.

Hinweis:
Im Zuge des technischen Fortschrittes setzt R&S zunehmend Metallschichtwiderstände mit 1% Toleranz anstelle von Kohleschichtwiderständen mit 5% Toleranz ein. Metallschichtwiderstände können sich dabei an Stellen befinden, an denen gemäß Schaltteilliste Kohleschichtwiderstände vorgesehen sind. Etwaige geringfügige Differenzen der Nennwerte zwischen Stromlaufplan, Schaltteilliste und Gerät liegen im zulässigen Toleranzbereich.

Colour code for resistors and capacitors

Note:
The electrical values of the largely miniaturized components are mainly identified by a colour code, the meaning of which can be taken from the table below.

N. B.:
Following the state of the art R&S makes increasing use of metal-film resistors (1% tolerance) instead of carbon-film resistors (5% tolerance). Metal-film resistors may have been employed where carbon-film resistors are specified in the parts list. Any slight differences of nominal values between circuit diagram, parts list and equipment are within tolerance.

Code couleur pour résistances et condensateurs

Remarque:
Les valeurs électriques des composants fort miniaturisés sont indiquées dans la plupart des cas par un code couleur dont voici l'explication.

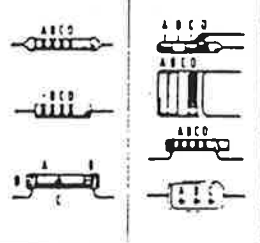
N. B.:
Suivant le progrès technique R&S utilise de plus en plus des résistances à film métallique (tolérance 1%) au lieu des résistances à couche de carbone (tolérance 5%). Des résistances à film métallique peuvent se trouver en des points où des types à couche de carbone figurent dans la liste des composants. Les différences minimes des valeurs nominales existant éventuellement entre le schéma de circuit, la liste des composants et l'appareil sont dans la marge de tolérance.

Farbe/Colour/Couleur	A	B	C	D
Schwarz/Black/Noir	—	0		
Braun/Brown/Marron	1	1	0	± 1%
Rot/Red/Rouge	2	2	00	± 2%
Orange/Orangé	3	3	000	
Gelb/Yellow/Jaune	4	4	0000	
Grün/Green/Vert	5	5	00000	± 0.5%
Blau/Blue/Bleu	6	6	000000	
Violett/Violet	7	7	—	± 0.1%
Grau/Gray/Gris	8	8	—	
Weiß/White/Blanc	9	9	—	
Gold/Doré	—	—	—	± 5%
Silber/Silver/Argenté	—	—	—	± 10%
Ohne Farbe/No colour/ Pas de couleur	—	—	—	± 20%

1) Toleranzring, hier nicht spezifiziert.
1) Tolerance ring, here not specified
1) Anneau de tolérance, ne pas spécifié ici

Anordnungsbeispiele für / Examples for / Exemple pour

Widerstände (R) / Resistors (R) / Résistance (R)	Kondensat. (C) / Capacitors (C) / Condensateur (C)



Definition* / Définition *

Kennzeichen A (Bauteilfarbe/1. Farbring) = 1. Zahl
Kennzeichen B (Bauteilende/2. Farbring) = 2. Zahl
Kennzeichen C (Punkt/3. Farbring) - 3. Zahl = Zahl der Nullen
Kennzeichen D (Punkt/4. Farbring) = Toleranz des Nennwerts in %
(Fehlendes Kennzeichen für D bedeutet ±20%)
Das Fehlen eines Kennzeichens bedeutet, daß die Farbe des Bauteilkörpers die Wertangabe darstellt.

Marking A (body colour or first coloured ring) = 1st digit
Marking B (body end or second coloured ring) = 2nd digit
Marking C (dot or third coloured ring) = number of zeroes
Marking D (dot or fourth coloured ring) = tolerance on nominal value in %
(with no D marking tolerance ± 20%)
The absence of a marking signifies that the body colour gives the corresponding information

Repérage A (couleur du corps ou 1er anneau) = 1er chiffre
Repérage B (bout du corps ou 2e anneau) = 2e chiffre
Repérage C (point ou 3e anneau) = nombre de zéros
Repérage D (point ou 4e anneau) = tolérance en % de la valeur nominale
(L'absence du repérage D signifie ± 20%)
L'absence de tout repérage signifie que la couleur du corps du composant représente la valeur correspondante.

* Siehe auch DIN 41 429 und DIN 40 825
* see also IEC publication 62-1952 and 62-1968
* Voir aussi DIN 41 429 et DIN 40 825

ROHDE&SCHWARZ

Zusammenstellung der lieferbaren Netzkabel
List of power cables available
Liste des câbles d'alimentation disponibles

Sach-Nr. Stock No. Référence	Schutzkontaktstecker nach: Earthed-contact connector: Fiche à contact de protection:	Vorzugsweise verwendet in: Preferably used in: Utilisé de préférence en:
DS 006.7013	BS 1363: 1967' 13A entspr. IEC 83: 1975 Standard B2 BS 1363: 1967' 13A complying with IEC 83: 1975 Standard B2 BS 1363: 1967' 13A suivant CEI 83: 1975 norme B2	Großbritanien Great Britain Grande-Bretagne
DS 006.7020	Typ 12 nach SEV-Vorschrift 1011.1059, Normblatt S 24 507 Type 12 complying with SEV regulation 1011.1059, standard sheet S 24 507 Type 12 suivant la norme SEV 1011.1059, feuille S 24 507	Schweiz Switzerland Suisse
DS 006.7036	Typ 498/13 nach USA-Vorschrift UL 498, bzw. IEC 83 Type 498/13 complying with US regulation UL 498 or with IEC 83 Type 498/13 suivant la norme E.U.A. UL 498 ou la norme CEI 83	USA / Kanada USA / Canada E.U.A. / Canada
DS 006.7107	Typ SAA3 10 A, 250 V, nach AS C112-1964 Ap. Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap. Type SAA3 10 A, 250 V, suivant AS C112-1964 Ap.	Australien Australia Australie
DS 025.2365	DIN 49 441, 10 A, 250 V	Europa (ohne Schweiz) Europe (Switzerland not included) Europe (Suisse non comprise)

Cross-Reference List of Class Designation Letters

IEC Publication 113-2 (1971) Item Designations, Letter Codes
ANSI Y32.2-1975 (IEEE Std 315-1975), Section 22, Class Designation Letters

Note: The designation letters used in the R&S Manuals correspond to the letter codes of the IEC Standard identified in the first column!

IEC Publication 113-2 Terminology	Letter Code IEC	Letter Code Y32.2
Acoustical indicator	H	LS
Adjustable resistor	R	R
Aerial	W	E
Amplifier	A	AR
Amplifier (with tubes)	A	AR
Arrester	F	E
Assemblies	A	A,U
Auxiliary switch	S	S
Battery	G	BT
Bistable element	D	U,A
Brake	Y	MP
Busbar	W	W
Cable	W	W
Cable balancing network	Z	Z
Capacitor	C	C
Changer	U	A,B,G,MT
Circuit breaker	Q	CB
Clutch	Y	MP
Coder	U	U,A
Compander	Z	A
Connecting stage	S	S
Contactors	K	K
Control switch	S	S
Converter	U	A,U,MG
Core, storage	D	E
Crystal filter	Z	FL
Crystal transducer	B	Y
Current transformer	T	T
Delay device	D	DL
Delay line	D	DL
Demodulator	U	A
Dial contact	S	S
Diode	V	D
Dipole	W	E
Disconnecting plug	X	P
Disconnecting socket	X	X
Discriminator	U	A
Disk recorder	D	A
Dynamotor	B	MG
Electrically operated mechanical device	Y	MT
Electronic tube	V	V
Equalizer	Z	EQ
Filter	Z	FL
Frequency changer	U	A,B,G
Fuse	F	F
Gas discharge tube	V	V
Generator	G	G
Heating device	E	HR
Hybrid	Z	Z
Indicating device	P	DS
Induction coil	L	L
Inductors	L	L
Integrating measuring device	P	M,MT,Z
Inverter	U	A,U,PS,MG
Isolator	Q	AT
Jumper wire	W	W
Laser	A	MT,A
Lighting device	E	DS
Limit switch	S	S
Limiter	Z	MT,RE
Line trap	L	FL,MP,V
Loudspeaker	B	LS
Magnetic amplifier	A	AR
Magnetic tape recorder	D	A
Maser	A	A
Measuring equipment	P	M
Microphone	B	MK
Miscellaneous	E	E
Modulator	U	A
Monostable element	D	A,U
Motor	M	B
Optical indicator	H	DS
Oscillator	G	Y,G
Overvoltage discharge device	F	F,E
Parabolic aerial	W	E
Photoelectric cell	B	V
Pickup	B	PU
Plug	X	P
Pneumatic valve	Y	MP
Potentiometer	R	R
Power switchgear	Q	CB,S
Protective device	F	F
Pushbutton	S	S
Quartz-oscillator	G	Y
Recording device	P	A,M
Register	D	A,U,M
Relay	K	K
Resistor	R	R
Resolver	B	B
Rheostat	R	R
Rotating frequency generator	G	G,MG
Rotating generator	G	G
Selector	S	S
Selector switch	S	S
Semiconductor	V	D,CR,Q
Shunt (resistor)	R	R
Signal generator	P	A
Signaling device	H	DS
Socket	X	X
Soldering terminal strip	X	E,TB
Static frequency changer	U	A
Storage device	D	A,U
Subassembly	A	A
Supply	G	A,PS
Supply device	G	A,PS
Synchro	B	B
Telegraph translator	U	A
Terminal	X	E
Terminal board	X	TB
Termination	Z	AT
Test jack	X	E,J
Testing equipment	P	A
Thermistor	R	RT
Thermo cell	B	A,TC
Thermoelectric sensor	B	A
Thyristor	V	Q
Transducer (nonelectrical quantity to electrical quantity)	B	A,BT
Transformer	T	T
Transmission path	W	W
Transistor	V	Q
Tube (electron)	V	V
Voltage transformer (potential)	T	T
Waveguide	W	W
Waveguide directional coupler	W	DC

Chapter 1
Introduction

The UPL is a versatile audio analyzer with excellent specifications that are achieved by combining precise analog technology with fast digital signal processing.

Maintenance or repair in the case of a fault must therefore be carried out by trained personnel.

In the following it is assumed that both the electrical safety regulations for the protection of the user are observed and the necessary measures are taken to protect the instrument against mechanical or electrical damage. In particular, the regulations for handling ESD[1]-sensitive electronics are to be observed. The safety precautions required will not be mentioned again in the following chapters.

Due to the large number of tests required after repair to the component level, repair can usually only be performed by replacing the module. This service manual is intended to help to identify the faulty module, replace the module, test the instrument characteristics after module replacement and adjust them, if necessary.

The service manual consists of two volumes:

The first volume contains a list of the recommended measuring equipment and calibration hints.
The section **Performance Test** contains the instructions for checking the UPL and the options and a form for the test report.
The section **Adjustment** describes all adjustments that may have to be performed for calibration or following module replacement so that the technical data of the UPL meet the specifications of the data sheet.
The section **Theory of Operation** describes the interaction of the UPL modules during a measurement or signal generation.
Hints on troubleshooting and module replacement are also to be found in the section **Repair**. A list of all available spare and replacement parts is provided at the end of this section.

The second volume contains Circuit Diagrams, Component Plans, XY Lists, Parts Lists, Interface Descriptions and the Installation Instructions for the options.

[1] ESD = electrostatic discharge

1.1 Service Conception

1. **Mounting the Options**

   - Hardware Options UPL-B1, -B2, -B5.
     Can be mounted by the customer.
   - Software Options UPL-B4, -B10, -B21, -B22.
     Can be installed by the customer.

   The UPL automatically detects a new hardware option.
   A detailed installation description comes with the option.
   No test equipment is required.

2. **Module Replacement**

   Should be performed by authorized personnel of R&S representatives only.

3. **Repair to component level**

   This is not recommended.

4. **Calibration**

   The performance verification can be performed according to the performance test procedure as described in this manual.

1.1.1 Mounting the Hardware Options

- Options:
  - UPL-B1, Low Distortion Generator
  - UPL-B2, Digital Audio I/O
  - UPL-B5, Audio Monitor

- Installation:
  - Can be mounted by the customer.
  - A detailed installation description
    a) comes with the option and
    b) is included in Volume 2 of this Service Manual.
  - The UPL automatically detects the new option.
  - All options are factory tested and adjusted.
  - After having installed the option, a short function test should be performed. It is described in section 5.2, starting on page 5.22. A short performance test is described, too.
  - No test equipment is required for the short function test.

1.1.2 Installing the Software Options

- Options:
  - UPL-B4, Remote Control
  - UPL-B10, Universal Sequence Controller
  - UPL-B21, Digital Audio Protocol
  - UPL-B22, Jitter and Interface Test

- Installation:

- Can be installed by the customer.
- A detailed installation description
  a) comes with the option and
  b) is included in Volume 2, Register 8 of this Service Manual.
  An installation key (5 digit number) has to be entered into the UPL via the front panel keyboard.

1.1.3 Module Replacement

- General:
  - Most printed circuit boards, mounted in the analog or digital section of the UPL, can be removed and remounted very easily.
  - For every module a detailed description, including adjustment and testing after replacement, is given in this manual.
  - Because of necessary testing afterwards, module replacement should be performed by authorized personnel of R&S representatives only.
- Module Replacement:
  - All new printed circuit boards are factory tested and adjusted.
  - Correction data for the Analog Unit is stored in an E^2PROM on the board. Thus no final adjustment is necessary after board replacement.
  - After having replaced the XLR Adapter (A90) or the Analog Unit (A3), it is necessary to check the common mode rejection of the analyzer and the output balance of the generator. This requires no measuring instruments but some test adapters, as described in the performance test.
  - After having installed the new board, a short function test should be performed. A short performance test is recommended too. These tests are described in section 5.2, starting on page 5.14.
  - No test equipment is required for the short function test.

1.1.4 Repair to component level

This is not recommended, because extensive performance verification is required after repair of almost any digital or analog board.
Maintenance on UPL has to be performed by module replacement only.

1.2 Measurement Equipment

The following list provides an overview of the required measurement equipment and tools. The column T or A shows a mark if the respective measuring device is required for a test or an adjustment. A more detailed list is to be found in section 2.1, page 2.1.

- **Measuring instruments**

Measuring equipment	T	A	Remark
Digital multimeter (AC, DC, ohm measurement)	•	•	
Frequency counter	•	•	
Audio Analyzer (UPD) with Option UPD-B1, Low Distortion Generator	•	•	
Low Distortion Generator (UPL-B1)	•		if not contained in DUT (UPL)
Oscilloscope	•	•	only for UPL-B2 and troubleshooting
Squarewave generator	•		only for UPL-B2

- **Commercially available auxiliary means**

Measuring equipment	T	A	Remark
2 adapters XLR male to BNC	•	•	
2 adapters XLR female to BNC	•	•	
Adapter BNC socket to 2*banana plug	•	•	
BNC T-junction	•	•	
BNC junction, female			
BNC termination 75 Ω	•	•	only for UPL-B2
BNC cable 75 Ω	•	•	only for UPL-B2
BNC cable 50 Ω	•	•	
Balanced cables with XLR connectors	•	•	

- **Special auxiliary means**

Measuring equipment	T	A	Remark
Cable from 6.3mm jack plug to 2*BNC or 2*XLR plug			only for UPL-B5
Passive RC lowpass for DFD d2 measurement	•		
Passive RC highpass for MOD DIST measurement	•		
4 passive RC notch filters for THD measurement, notch frequencies 20 Hz, 1 kHz, 7 kHz and 20 kHz	•		only for UPL-B1
Resistor network with 985 Ω and 995 Ω, used for THD and DFD measurement	•		for testing the analyzer
Resistor network with 85 Ω and 100 kΩ, used for THD measurement, notch filter and MOD DIST measurement	•		for testing the analyzer
Test cable for measuring the output balance of the generator	•	•	
Test cable for measuring the source resistance of the generator	•	•	
Test cable for measuring the common-mode rejection of the analyzer	•	•	

- **Tools**

Measuring equipment	T	A	Remark
Phillips screwdriver, size 0			Front Panel Unit
Phillips screwdriver, size 1		•	module replacement
Phillips screwdriver, size 2		•	Open UPL
Phillips screwdriver, size 0, insulated		•	trimmers
Screwdriver, size 0, insulated		•	trimmers
Screwdriver, size 2 or 3			power supply
Screwdriver, size 4			power supply
Wrench, size 10			transformer

1.3 Calibration

The recommended calibration interval is two years.

The specification of the data sheet can be checked using the performance test procedure as described in this manual.

Due to the amout of tests and of measurement equipment (instruments and special auxiliary means) it is recommended that the calibration is carried out by a R&S service representative.

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Chapter 2
Performance Test

Ambient temperature: 23 ± 10 °C (73 ± 18 °F)

Warm-up time of UPL: 1 hour

2.1 Recommended Measurement Equipment

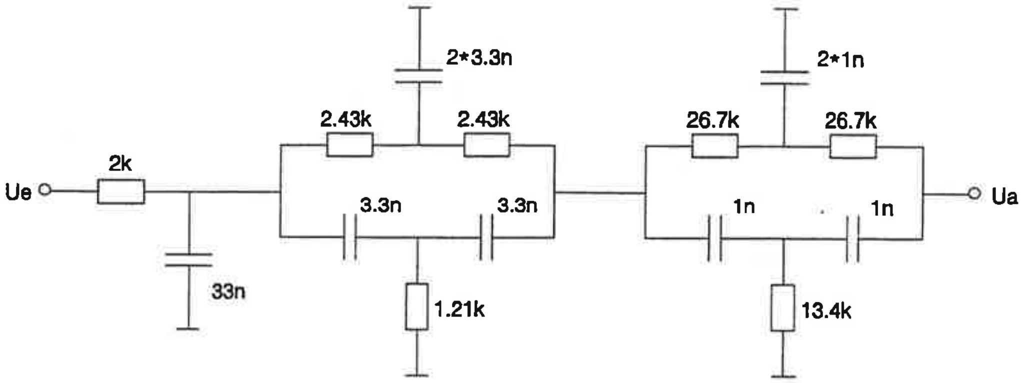
Measuring instrument	Specifications		Example
Digital Multimeter as AC Voltmeter	AC, DC, Ohm measurement 2 Hz – 110 kHz 15 mV – 24 V ±0.06 % ±0.15 % Input impedance > 1 MΩ	 10 Hz – 20 kHz 20 kHz – 100 kHz	HP3458A
as DC Voltmeter	±0.05 %	100 mV – 100 V	
as Ohm meter	±0.025 %	5 Ω – 200 kΩ	
Frequency counter	±5 ppm, 10 Hz – 110 kHz		Philips PM6680
Audio Analyzer	THD+N < –105 dB < –88 dB Fundamental < 20 kHz	Bandwidth 20 kHz 100 kHz	R&S UPL (DUT)
Audio Analyzer	THD < –96 dB < –100 dB < –110 dB < –92 dB	Fundamental 10 Hz – 20 Hz 20 Hz – 100 Hz 100 Hz – 7 kHz 7 kHz – 50 kHz	R&S UPD
	MOD DIST < –96 dB, (< –90 dB) < –96 dB, (< –85 dB) Lower Freq 200 Hz – 500 Hz values in ( ) for Lower Freq 30 Hz – 200 Hz	Upper Freq 4 kHz – 15 kHz 15 kHz – 20 kHz	
	DFD d3 < –96 dB Diff Freq 80 Hz – 1 kHz	Mean Freq 5 kHz – 20 kHz	
	Selective rms measurement 20 Hz – 20 kHz 0.1 μV sensitivity		
Oscilloscope	Bandwidth 100 MHz, 2 Channels		TDS 410A
Square wave Gen.	TTL, 27 to 55 kHz		APN

Signal Generator 1 as Sine Generator	Sine, Multisine, Low Distortion, DC 10 Hz – 110 kHz 100 mV – 24 V, BAL 10 Ω 100 mV – 12 V, UNBAL 15 Ω		R&S UPD + UPD-B1
as Multi Sine Generator	10 Hz – 110 kHz ±50 ppm 1 mV – 24 V, BAL 10 Ω 1 mV – 12 V, UNBAL 15 Ω ±0.5 % ±1 %	 20 Hz - - 20 kHz 20 kHz – 110 kHz	
as Low Distortion Generator	10 Hz – 110 kHz ±0.1 % 100 mV – 24 V, BAL 10 Ω 100 mV – 12 V, UNBAL 15 Ω ±0.5 % ±1 %	 20 Hz - - 20 kHz 20 kHz – 110 kHz	
	THD < –107 dB < –113 dB < –107 dB < –92 dB < –86 dB	Fundamental 10 Hz 25 Hz – 7 kHz 7 kHz – 20 kHz 20 kHz – 50 kHz 50 kHz – 100 kHz	R&S UPD
	THD+N < –105 dB < –90 dB	Bandwidth 22 kHz 110 kHz	
	MOD DIST < –96 dB, (< –90 dB)	Upper Freq 4 kHz – 20 kHz	
as DC Source	±100 mV – ±5 V, BAL 10 Ω		
Signal Generator 2	Sine, Multisine, Low Distortion		R&S UPL + UPL-B1 (DUT)

Measuring instrument	Specifications	Example
XLR/BNC Adapter set	2 from XLR male to BNC 2 from XLR female to BNC	UPL-Z1
Adapter	from BNC female to 2∗banana jacks Order No. FJ 0099.6687.00	R&S
BNC T-junction	Order No. FJ 0017.6588.00	R&S
Junction	BNC-BNC female Order No. FJ 0017.6559.00	R&S
Termination	75 Ω, BNC Order No. FJ 0265.6862.00	RMF 2
Test cable for output resistance	Special cable with 4 Banana jacks and XLR cable-female	— —
Test cable for output balance	Special cable with BNC and XLR female cable connection, 2∗ 300 Ω precision resistors and 10 kΩ resistor built in	— — —
Test cable for common-mode rejection	Special cable w. BNC and XLR male cable connector built in 2∗ 300 Ω precision resistors	— —
Adapter	Cable connecting 1/4" phone jack to 2∗BNC- or 2∗XLR-male connector	—
Cables	BNC Cables Balanced Cables with XLR connectors	— —
Cable	BNC-Cable 75 Ω	—
Differential-tone lowpass (LP DFD)	passive RC lowpass for DFD d2 measurement Attenuation < 5 dB for f < 1 kHz Attenuation > 35 dB for f > 5 kHz	—
Intermodulation highpass (HP MOD DIST)	passive RC highpass for MOD DIST measurement Attenuation >40 dB for f < 500 Hz Attenuation <5 dB for f > 4 kHz	—
Notch filter (NOTCH THD)	4 passive RC notch filters for THD measurement Notch frequencies 20 Hz, 1 kHz, 7 kHz and 20 kHz Attenuation > 60 dB for the fundamental Attenuation < 10 dB for the harmonics	—
Resistance network (RES NET 1)	2 resistors 985 Ω and 995 Ω shielded construction with 3 BNC for THD, MOD DIST and DFD signal generation	—
Resistance network (RES NET 2)	2 resistors 85 Ω and 100 kΩ shielded construction with 3 BNC for THD and MOD DIST signal generation	—

Differential-tone lowpass LP DFD

Circuit diagram:



Construction:
To avoid any interference, the filter should be built in a metal housing. Use BNC connectors for input and output.

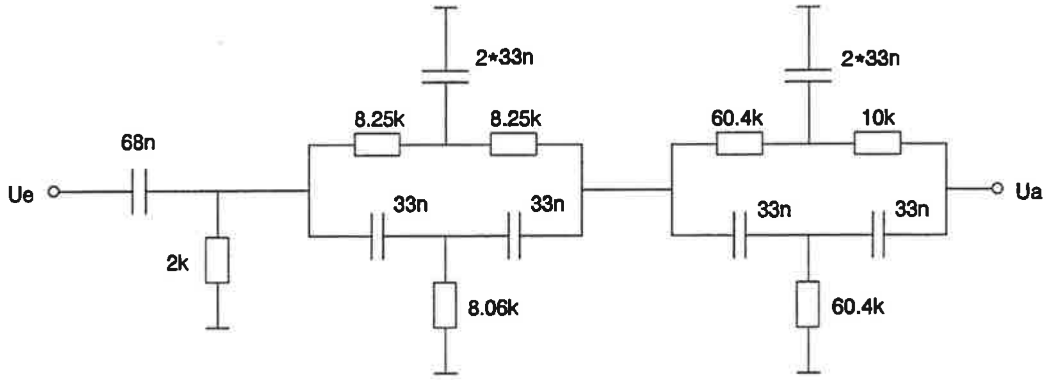
Components:

Resistors metal film, ±1 % tolerance	
Value	R&S Order No.
1.21 kΩ	RL 0083.0655.00
2.00 kΩ	RL 0083.0826.00
2.43 kΩ	RL 0083.0884.00
13.3 kΩ	RL 0082.2577.00
26.7 kΩ	RL 0083.1597.00

Capacitors Polypropylene, ±1 % tolerance	
value	R&S order no.
1.0 nF	CK 0007.7598.00
3.3 nF	CK 0007.7623.00
33 nF	CK 0007.7681.00

Intermodulation highpass HP MOD DIST

Circuit diagram:



Construction:

To avoid any interference, the filter should be built in a metal housing. Use BNC connectors for input and output.

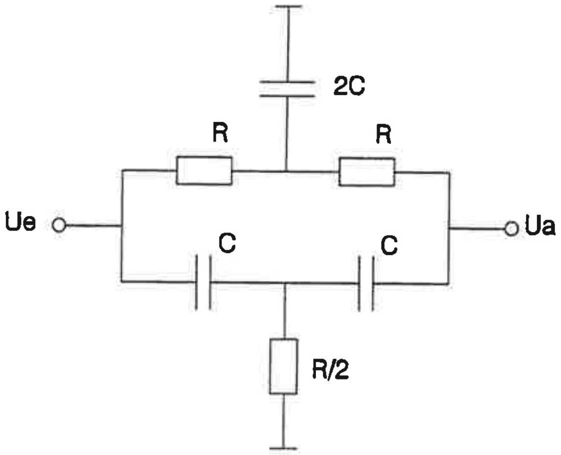
Components:

Resistors metal film, ±1 % tolerance		Capacitors Polypropylene, ±1 % tolerance	
Value	R&S Order No.	value	R&S order no.
2.00 kΩ	RL 0084.3793.00	2.2 nF	CK 0007.7617.00
8.06 kΩ	RL 0083.1222.00	33 nF	CK 0007.7681.00
8.25 kΩ	RL 0083.1239.00		
10.0 kΩ	RL 0083.1297.00		
60.4 kΩ	RL 0083.1851.00		

The 68 nF capacitor can be built out of two 33 nF and one 2.2 nF capacitors in parallel.

Notch filters NOTCH THD, for THD measurement of generator

Circuit diagram:



Construction:

To avoid any interference, the filter should be built in a metal housing. Use BNC connectors for input and output.

Components:

Resistors: Metal film resistors, ±0.1 % tolerance
Capacitors: Polypropylene, ±1 % tolerance

Notch frequency f_1	R	R&S Order No.	C	R&S Order No.
20 Hz	24.0 kΩ	RL 0084.3793.00	330 nF	CK 0008.1893.00
1 kHz	4.81 kΩ	RL 0084.2451.00	33 nF	CK 0007.7681.00
7 kHz	3.32 kΩ	RL 0084.2145.00	6.8 nF	CK 0007.7646.00
20 kHz	2.40 kΩ	RL 0083.9875.00	3.3 nF	CK 0007.7623.00

Notch frequency:

$$f_1 = \frac{1}{2\pi RC}$$

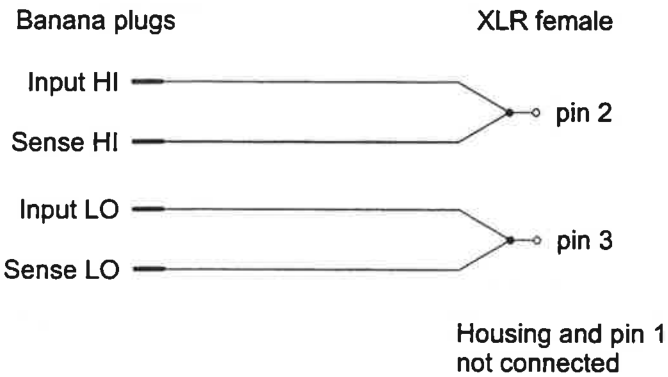
The attenuation $a_n = U_e/U_a$ of the notch filter for the harmonics $n * f_1$ of the fundamental f_1 must be taken into account with the THD measurement:

Frequency	Attenuation	a_n
f_1	>60 dB	—
$2 * f_1$	9.1 dB	2.85
$3 * f_1$	5.1 dB	1.80
$4 * f_1$	3.3 dB	1.50
$5 * f_1$	2.3 dB	1.30

Test cable for the measurement of the source resistance

Materials: XLR female cable connector
2 two-leaded cables
4 banana jacks

Construction:



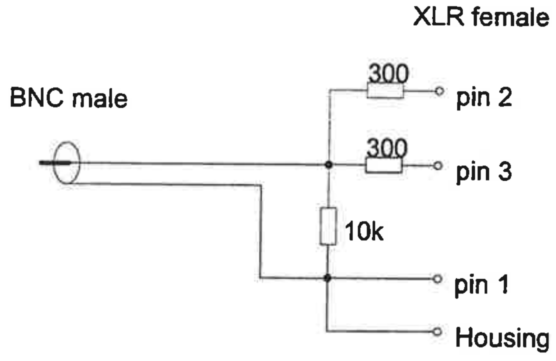
Test cable for the measurement of the output balance

Materials: XLR female cable connector, consisting of:
– Housing (Order name: NM3FXI, Neutrik)
– Cable outlet (Order name: CML, Neutrik)
BNC cable
10-kΩ-resistor (metal film, tolerance ±1 %)
2 matched 300-Ω-resistors

The two 300-Ω resistors must be matched to an accuracy of at least 0.01 % in order to achieve a measurement limit of < –90 dB. The absolute value is not important, but it should be in the range between 295 Ω and 305 Ω.

The two matched 300-Ω-resistors can be ordered with the order no. 0633.8289.00 as spare part from R&S, Zentralservice München (ΔR < 0.005 %, ΔTK < 1 ppm/K).

Construction: These three resistors must be installed in the XLR female cable connector.



Test cable for the measurement of the common mode rejection

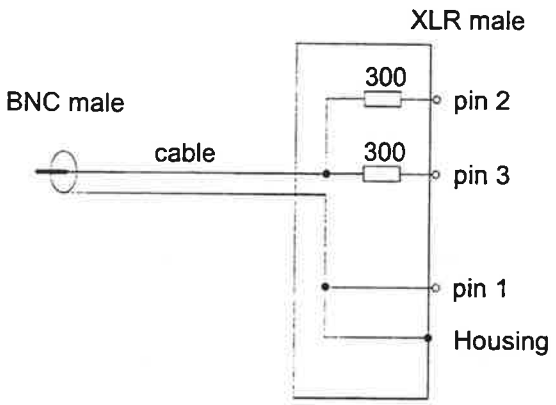
Materials:
XLR male cable connector, consisting of:
- Housing (Order name: NM3MXI, Neutrik)
- Cable outlet (Order name: CML, Neutrik)

BNC cable
2 paired 300-Ω-resistors

The two 300-Ω resistors must be matched to an accuracy of at least 0.01 %. The absolute value is not important, but it should be in the range between 295 Ω and 305 Ω.

The two matched 300-Ω-resistors can be ordered with the order no. 0633.8289.00 as spare part from R&S, Zentralservice München (ΔR < 0.005 %, ΔTK < 1 ppm/K).

Construction: The 2 resistors are built in the XLR male cable connector.



Cable from XLR female to 2* banana jacks

Materials:
symmetrical cable
2 banana jacks

Construction: Remove **male** connector from XLR cable.
Connect banana jack for Input HI with pin 2 of the XLR female connector.
Connect banana jack for Input LO with pin 3 of the XLR female connector.
The shielding is not connected.

NOTE: Instead of this cable the following adaptation can be used:
Adapter XLR/BNC, UPL-Z1, Order No. 1078.3704.02
+ BNC cable, commercially available
+ Adapter BNC female to 2*banana jacks, R&S Order No. FJ 0099.6687.00

Cable from XLR female connector to BNC male

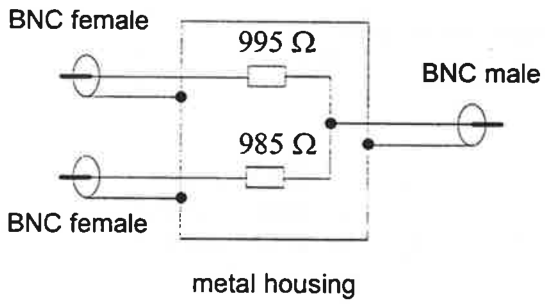
Materials: XLR female connector
BNC cable

Construction: Remove BNC connector on one side of the BNC cable.
Connect pin 2 of the XLR female connector with the inner conductor of the BNC cable.
Connect pin 3 of the XLR female connector with the shielding of the BNC cable.
Pin 1 and the case are not connected.

NOTE: Instead of this cable the XLR/BNC adapter UPL-Z1, Order No. 1078.3704.02, may be used.

Resistance Network RES NET 1

Curcuit Diagram and Construction:



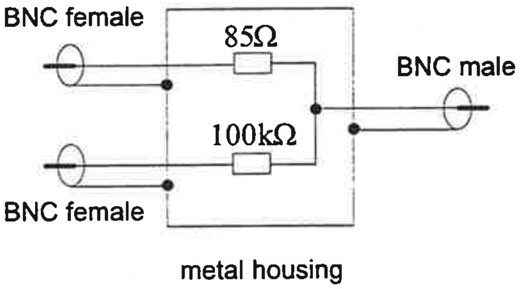
Materials: 3 BNC for case mounting
1 metal housing

Components:

Resistors (metal film)		
Value	Tolerance	R&S Order No.
995 Ω:	±0.1 %	
built in parallel from		
1 kΩ	±0.1 %	RL 0083.9146.00
66.5 kΩ	±0.1 %	RL 0084.4648.00
985 Ω	±0.1 %	
built in parallel from		
1 kΩ	±0.1 %	RL 0083.9146.00
200 kΩ	±1 %	RL 0083.2235.00

Resistance Network RES NET 2

Curcuit Diagram and Construction:



Materials: 3 BNC for case mounting
1 metal housing

Components:

Resistors (metal film)		
Value	Tolerance	R&S Order No.
85 Ω:	±0.1 %	
built in parallel from		
150 Ω	±0.1 %	RL 0083.7566.00
196 Ω	±0.1 %	RL 0084.0795.00
100 kΩ	±0.1 %	RL 0084.4983.00

2.2 Test Sequence

2.2.1 Performance Test Analog Generator

Adaptation of the measuring instruments to the generator output:

The output of the generator is XLR male. The balanced signal is applied between pin 2 and pin 3. The same is true for the unbalanced signal, however: pin 2 is HI, pin 3 is LO (corresponding to AES-14). The inputs of the digital multimeter are banana jacks, the input of the frequency counter is a BNC socket. Therefore, direct connection via a commercially available cable is not possible. The easiest way of adaptation is as follows:

- ▷ Retrofit the outputs of the generator to BNC female using UPL-Z1 (XLR/BNC adapter set).
- ▷ Retrofit the input of the digital multimeter to BNC female using an adapter BNC female to 2*banana plug.
- ▷ Commercially available BNC cables can then be used for further connections.

As an alternative, special cables XLR female to 2*banana plug and XLR female to BNC female can be manufactured. The configuration of such cables is described in section 2.1, starting at page 2.8.

Before starting the test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE` → `Mode` → `DEF SETUP`.

2.2.1.1 Sinewave Level Accuracy at 1kHz

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	1.0000 kHz
VOLTAGE	*)

*) set according to test report

Measuring instrument:
AC voltmeter

Measurement: Connect AC voltmeter to output of UPL generator.
To this end, use an adapter XLR female to 2*banana plug.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustments:
→ Level adjustment analog generator
→ LF adjustment lowpass 23 kHz

2.2.1.2 Sinewave Frequency Response

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:
AC voltmeter

Measurement: Connect AC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.
Relative display in dB, reference is the voltage measured at 1 kHz.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustments:
→ LF adjustment lowpass 23 kHz
→ 20-kHz adjustment lowpass 23 kHz

2.2.1.3 Sinewave Frequency Accuracy

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	1.0000 kHz
VOLTAGE	1.0000 V

Measuring instrument:
Frequency counter

Measurement: Connect frequency counter to output of UPL generator.
To this end, an adapter XLR female to BNC female is required.

2.2.1.4 DC Offset 0 V: Offset Error

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
DC Offset	ON
	0.0000 V
FREQUENCY	1.0000 kHz
VOLTAGE	*)

*) set according to test report

Measuring instrument:
DC voltmeter

Test setup: Connect DC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.

CAUTION:
The diagnostic mode is used for the following measurements (see also section 3.3.1.1, page 3.12). The diagnostic mode permits extensive interventions in the UPL hardware. Therefore, perform the following settings very carefully and avoid faulty inputs.

Measurement: To enable measurement of the small DC offset, the AC level of the generator must be switched off. In order not to change the setting of the generator hardware, the AC level of the D/A converter for signal generation is switched off. To this end, diagnostic mode is used:

1. Enter the Diagnostic password 1.4142 in the OPTIONS panel.
2. Open diagnostic mode: Diag State → ON.
3. Set the AC voltage according to the test report on the UPL.
4. Switch off the AC level in diagnostic mode: DAC VoltAC → 0.
5. Measure the DC voltage using the DC voltmeter.
6. Continue with 3. until the measurement sequence is finished.
7. Quit diagnostic mode: Diag State → OFF.

NOTE:
This test is affected by the following adjustment:
→ DC-offset adjustment

2.2.1.5 DC Offset: Setting Error

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
DC Offset	ON, *)
FREQUENCY	1.0000 kHz
VOLTAGE	0.0000 V

*) set according to test report

Measuring instrument:
DC voltmeter

Measurement: Connect DC voltmeter to output of UPL generator and measure the DC voltage at the output of the UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustment:
→ Level adjustment analog generator
→ DC-offset adjustment

2.2.1.6 THD+N Inherent Distortion

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:
Analyzer for THD+N: UPD

Setting of the UPD analyzer for:

22 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	1
Ch1 Input	*)
Ch1 Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim Low	20.00 Hz
FrqLim Upp	21.90 kHz

100 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 100kHz
Channel(s)	1
Ch1 Input	*)
Ch1 Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim low	150.00 Hz
FrqLim upp	100.00 kHz

*) set according to UPL generator Output,
Input BAL with impedance 20 kΩ.

Test setup: Connect UPD analyzer to output of UPL generator
Output BAL: Use balanced cable (XLR).
Output UNBAL: Use adapter XLR female to BNC female and an unbalanced cable (BNC).

Measurement: Further UPL setting and measurement according to test report.

2.2.1.7 MOD DIST Inherent Distortion

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	MOD DIST
UPPER FREQ	*)
LOWER FREQ	60 Hz
VOLT LF:UF	4.0000 : 1
TOTAL VOLT	20.000 Vpp

*) set according to test report

Measuring instrument:
Analyzer for MOD DIST: UPD

Set UPD:

Analyzer	
INSTRUMENT	ANLG 22 kHz
Channel(s)	1
Ch1 Input	UNBAL BNC
Ch1 Range	AUTO
FUNCTION	MOD DIST
Dyn Mode	PRECISION
Unit	dB

Auxiliary means:

External RC highpass: HP MOD DIST

Test setup: Connect HP MOD DIST between output of UPL generator and input of UPD analyzer. To this end, an adapter XLR female to BNC female is required. The highpass eliminates the influence of the inherent distortions of the analyzer. The attenuation of the highpass in the passband does not affect the measurement.

Measurement: Further UPL setting and measurement according to test report.

2.2.1.8 DFD Level Accuracy

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	DFD
DC Offset	OFF
MEAN FREQ	*)
DIFF FREQ	425.00 Hz
TOTAL VOLT	1.0000V

*) set according to test report

Measuring instrument:

AC voltmeter

Measurement: Connect AC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.
Measure the RMS value of the output voltage of the UPL generator.
Furher UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustment:
→ Level adjustment analog generator

2.2.1.9 DFD d2 Inherent Distortion

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	DFD
DC Offset	OFF
MEAN FREQ	*)
DIFF FREQ	425.00 Hz
TOTAL VOLT	5.0000V

*) set according to test report

Measuring instrument:

Selective voltmeter: UPD

Set UPD:

Analyzer	
INSTRUMENT	ANLG 22 kHz
Channel(s)	1
Ch1 Input	UNBAL BNC
Ch1 Range	AUTO
FUNCTION	RMS SELECT
Unit Ch1	dBr
Reference	VALUE: 3.5000 V
Bandwidth	BP 3 %
FREQ MODE	FIX: 425.00 Hz

Auxiliary means:

External RC lowpass: LP DFD

Measurement procedure:

▷ Connect the LP DFD between output of UPL generator and input of UPD analyzer. To this end, an adapter XLR female to BNC female is required.

▷ The lowpass eliminates the influence of the inherent distortions of the analyzer. The attenuation of the lowpass in the passband does affect the measurement and is taken into account in the reference value of the analyzer.

▷ Measure the RMS value of the voltage at the output of the lowpass selectively.

▷ The displayed measured value (in dBr) is the DFD d2 inherent distortion (in dB).

Measurement: Further UPL setting and measurement according to the test report

2.2.1.10 DFD d3 Inherent Distortion

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	DFD
DC Offset	OFF
MEAN FREQ	*)
DIFF FREQ	425.00 Hz
TOTAL VOLT	5.0000V

*) set according to test report

This is the same setting as the one used for the measurement of DFD d2.

Measuring instrument:

Analyzer for DFD d3: UPD

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22 kHz
Channel(s)	1
Ch1 Input	UNBAL BNC
Ch1 Range	AUTO
FUNCTION	DFD
Meas Mode	d3 (IEC268)
Unit	dB

Measurement: Connect UPD analyzer to output of UPL generator.
To this end, an adapter XLR female to BNC female is required.
Further UPL setting and measurement according to test report.

2.2.1.11 Output Impedance

The output impedance R_{off} of the deactivated channel is measured using an ohmmeter.
The output impedance R_{on} of the activated channel is calculated from the voltage division with a known impedance, e.g. the impedance R_{off} of the deactivated channel measured before.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	*)
Output	*)
Impedance	*)
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	1.0000 kHz
VOLTAGE	1.0000 V

*) set according to test report

Measuring instruments:

Digital multimeter for impedance measurement (ohmmeter)
AC voltmeter

Test setup for the measurement of R_{off}:

Connect ohmmeter to output of UPL generator.
R_{off} must be measured directly at the output terminals of the UPL. In order to avoid errors in measurement due to lead resistances, it is recommended to perform the impedance measurement using the four-wire technique. The configuration of an appropriate cable is described in section 2.1, page 2.7.

Measurement:

- ▷ Set UPL generator according to test report.
- ▷ Measure the impedance R_{off} of the deactivated channel using the ohmmeter.

Test setup for the measurement of R_{on}:

- ▷ Retrofit both channels of the UPL generator to BNC female using UPL-Z1 (XLR/BNC Adapter).
- ▷ Connect possibly short BNC cables **of the same length** to both channels (if the cables are of the same length, their lead resistances cancel each other out in the formula for R_{on}.
- ▷ Connect both BNC cables using a BNC T-junction.
- ▷ Connect AC voltmeter to the BNC T-junction. To this end, an adapter BNC female to 2*banana plug and a BNC-BNC female junction is required.

Measurement:

- ▷ Set channel(s) and output of generator according to test report.
- ▷ Disconnect the BNC cable from the deactivated channel.
- ▷ Measure AC, note the measured value as U_1.
- ▷ Reconnect the deactivated channel.
- ▷ Measure AC, note the measured value as U_2 ($U_2 \approx 0.5 * U_1$).

Calculate the output impedance R_{on} according to the following formula:

$$R_{on} = \frac{1}{\frac{1}{R_{off}(\frac{U_1}{U_2} - 1)} - \frac{1}{R_{ac}}}$$

where $R_{ac} =$ input impedance of the AC voltmeter
(neglectable if $R_{ac} > 1000 * R_{off}$)

If R_{ac} is neglectable, the formula for R_{on} is simplified as follows:

$$R_{on} = R_{off}(\frac{U_1}{U_2} - 1)$$

CAUTION:
For calculating R_{on} of **channel 1**, R_{off} of **channel 2** must used in the above formula and vice versa. R_{off} is known from the previous measurement.

2.2.1.12 Crosstalk

Due to the high crosstalk attenuation of typ. 120 dB a very small voltage of a few μV must be measured at the deactivated channel. For this purpose, a selective voltmeter as the one provided in the UPD analyzer, for example, is required.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	*)
Output	*)
Impedance	*)
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	20.000 kHz
VOLTAGE	10.00 V

*) set according to test report

Measuring instrument:
Selective voltmeter: UPD

Set UPD:

Analyzer	
INSTRUMENT	ANLG 22 kHz
Channel(s)	1
Ch1 Input	*)
Ch1 Range	AUTO
FUNCTION	RMS SELECT
Unit	dBr
Reference	VALUE: 10.000 V
Bandwidth	BP 3 %
FREQ MODE	FIX: 20.000 kHz

*) set according to UPL generator Output

Test setup: Connect UPD analyzer to output of UPL generator via a shielded cable.
Output BAL: use balanced cable (XLR).
Output UNBAL: Use an adapter XLR female to BNC female and an unbalanced cable (BNC).

Measurement:

- ▷ Setting of UPL generator according to test report.
- ▷ Selective RMS measurement on activated channel, a measured value of about 0 dBr (= 10 V) must be displayed.
- ▷ Switch generator to the other channel.
- ▷ Selective RMS measurement on the now deactivated channel. The measured value is the crosstalk.

2.2.1.13 Output Balance

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	*)
Output	BAL
Impedance	10 Ω
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	*)
VOLTAGE	10.000 V

*) set according to test report

Measuring instrument:

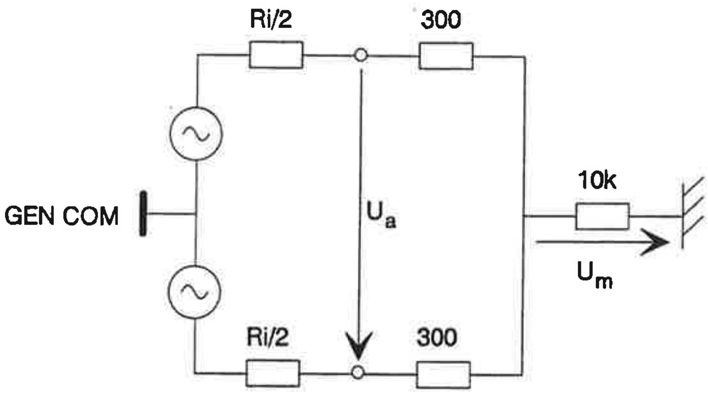
Selective voltmeter: UPD

Set UPD:

Analyzer	
INSTRUMENT	ANLG 22 kHz
Channel(s)	1
Ch1 Input	UNBAL BNC
Common	FLOAT
Ch1 Range	AUTO
FUNCTION	RMS SELECT
Unit	dBr
Reference	VALUE: 10.00 V
Bandwidth	BP 3 %
FREQ MODE	FIX: *)

*) set according to frequency of UPL generator

Test setup:



The two 300-Ω resistors must be matched to an accuracy of at least 0.01 % in order to achieve a measurement limit of < –90 dB. The absolute value is not important, but it should lie in the range between 295 Ω and 305 Ω.

The three resistors must be installed in an XLR female cable connector. The signal U_m is supplied via a BNC cable and applied to the unbalanced input of the analyzer.

The configuration of an appropriate cable is described in section 2.1, page 2.7.

Measurement:

- ▷ Set UPL generator according to test report.
- ▷ Selective RMS measurement on the activated channel. The displayed measured value (in dBr) is negative.
- ▷ Enter the measured value with positive sign as output balance (with the unit dB) into the test report.

NOTE:
This test is affected by the following adjustment:
→ Adjustment of output balance.

2.2.2 Performance Test Analog Analyzer

Before starting the test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP.`
For testing the rated specifications of the UPL Analog Analyzer, it is recommended to proceed according to the following test procedure:

2.2.2.1 Level Measurement RMS

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	RMS
Unit	*)

*) set according to test report

NOTE
The UPL analyzer is equipped with balanced (BAL) inputs for ranges from 18 mV to 30 V.
As quite a few internal range combinations are repeated, it is not necessary to measure all ranges (see also level table in section 1, page 4.3).
It is sufficient to test only the ranges 100 mV, 300 mV, 3 V, 6V and 30 V.

- Level accuracy at 1 kHz

  (see test report section 2.3.2, page 2.67)

  Measuring equipment:

  UPD generator: sinewave, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND

  AC voltmeter

  Test setup: Connect AC voltmeter to an output of the UPD generator: to this end, use adapter BNC socket to 2∗ banana plug, adapter XLR plug to BNC socket and XLR cable.
  Connect the XLR input of the UPL to be tested to the other output of the UPD generator via an XLR cable.

  Measurement: Set generator and UPL analyzer according to test report. Input voltage U_e = 0.75 ∗ rated range value!
  Measure the actual value of the input voltage using the AC voltmeter. Reference is the voltage measured at 1 kHz: → enter as reference for CH1 and CH2 in the analyzer panel. Read off the UPL display in dBr.

- Linearity at 20 kHz

  (see test report section 2.3.2, page 2.68)

Measuring equipment:

UPD generator: sinewave, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND
AC voltmeter

Test setup:

Connect AC voltmeter to an output of the UPD generator:
to this end, use adapter BNC socket to 2∗ banana plug, adapter XLR plug to BNC socket and XLR cable.
Connect the XLR input of the UPL to be tested to the other output of the UPD generator via an XLR cable.

Measurement:

Set generator and UPL analyzer and measure according to test report.
Measure the actual value of the input voltage at 1 kHz using the AC voltmeter.
Reference is the voltage measured at 1 kHz:
→ enter as reference for CH1 and CH2 in the analyzer panel.
Read off the UPL display ΔU_0 in dBr for each channel.
Repeat the procedure at the other frequencies.
Read off the UPL display ΔU_x in dBr for each channel.
The linearity error is obtained by forming the difference $\Delta U_x - \Delta U_0$ for each test value.

Note:

This test is used to ensure correct functioning of the UPL analyzer. The measurement results are no concrete data sheet values, but implicitly included in their error limits!

2.2.2.2 Frequency response

(see test report section 2.3.2, page 2.69)

UPL einstellen:

Analyzer	
INSTRUMENT	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	RMS
Unit	dBr

*) set according to test report

Measuring equipment:

UPD generator: sinewave, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND
AC voltmeter

Test setup:

Connect AC voltmeter to an output of the UPD generator:
to this end, use adapter BNC socket to 2 ∗ banana plug, adapter XLR plug to BNC socket and XLR cable.
Connect the XLR input of the UPL to be tested to the other output of the UPD generator via an XLR cable.

Measurement:

Set generator and UPL analyzer and measure according to test report.
Input voltage $U_e = 0.75 * $ nominal voltage of range!
Measure the actual value of the input voltage 1 V at 20 kHz using the AC voltmeter.
Reference is the voltage measured at 1 V:
→ enter as reference for CH1 and CH2 in the analyzer panel.
Read off the UPL display ΔU_0 in dBr for each channel.
Repeat the procedure for the other voltages.
Read off the UPL display ΔU_x in dBr for each channel.
Form the difference $\Delta U_x - \Delta U_0$ for each test value.

2.2.2.3 Inherent Noise

(see test report section 2.3.2, page 2.74)

Set UPL:

Analyzer	
Instrument	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	300 Ω
Range	FIX: 18 mV or AUTO
Function	RMS/QPEAK *)
Unit	V
Filter	*)

*) set according to test report

Test setup: UPL without input terminals

Measurement: Set UPL analyzer and measure according to test report.

2.2.2.4 Input Impedances

(see test report section 2.3.2, page2.75)

Set UPL:

Analyzer	
Channel(s)	2 ≡ 1
Impedance	*)
Range	FIX: 30.0 V
Function	DC

*) set according to test report

Measuring instrument:

Digital multimeter for impedance measurement

Measurement: Connect digital multimeter to the inputs of the UPL: to this end, use adapter BNC socket to banana plug, adapter XLR plug to BNC socket and XLR cable.
Set UPL analyzer and measure the input impedances according to the test report.

2.2.2.5 Crosstalk

(see test report section 2.3.2, page2.75)

Set UPL:

Analyzer	
Instrument	ANLG 22kHz
Channel(s)	2 & 1
Impedance	600 Ω (channel without signal) *)
Function	RMS SELECT
Unit	dBr
Freq Mode	FIX: 20kHz

*) set according to test report

Measuring instrument:

UPD generator: sinewave, 10 V, 20 kHz, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND

Test setup: Connect one XLR input of the UPL to one output of the UPD generator via an XLR cable. No signal is applied to the other input channel, which must be internally terminated with 600 Ω.

Measurement: Set UPL analyzer according to test report.

Store the measured value of the supplied channel as reference value. → Reference STORE CH1 or 2
The measured value of the other channel shows the crosstalk. (crosstalk attenuation with opposite sign!)
Check crosstalk of channel 1 → 2 and channel 2 → 1.

Note: Due to the high crosstalk attenuation of typ. 140dB a very small voltage of a few μV must be measured at the channel where no signal is applied.

2.2.2.6 Common-mode rejection

(see test report section 2.3.2, page 2.75)

Set UPL:

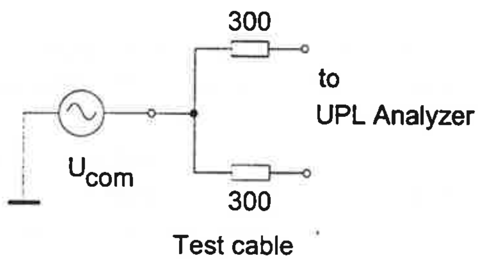
Analyzer	
Instrument	ANLG 22kHz
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
Function	RMS SELECT
Unit	dBr
Freq Mode	FIX: *)

*) Set respective generator frequency according to test report.

Measuring instrument:

UPD generator: sinewave, Channel(s) 2 ≡ 1, Output UNBAL, Impedance 5 Ω, Common GROUND

Test setup: Connect unbalanced output of UPD generator via BNC cable to Test cable for common-mode rejection and connect the latter to an XLR input of the UPL.



The two 300-Ω impedances must comply with each other with an accuracy of ±0.01 %. The absolute value is non-critical and should lie in the range from 295 to 305 Ω. (see section 2.1, page 2.8)

Measurement: Set UPL analyzer according to test report.
Store generator voltage as level reference value in the analyzer panel. → Reference STORE CH1 or 2
The measured value of the supplied channel shows the output balance with opposite sign.

2.2.2.7 Frequency Measurement

(see test report section 2.3.2, page 2.76)

Set UPL:

Analyzer	
Instrument	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Input	BAL
Impedance	200 kΩ
Range	FIX: 1.0 V
FREQ/PHASE	FREQ
Meas Time	250 ms
Unit	f/fr

*) set according to test report

Measuring equipment:
UPD Generator:
Frequency counter

Test setup: Connect frequency counter to an output of the UPD generator: to this end, use BNC cable, adapter XLR socket to BNC.
Connect the XLR input of the UPL to be tested to the other output of the UPD generator via an XLR cable.

Measurement: Set UPD-Generator and UPL analyzer according to test report.
Additional UPL setting: frequency display 6-digit →OPTIONS panel: → DISPLAY Read Resol CHOICE...
Measure generator frequency using frequency counter and store as frequency reference value in the analyzer panel: → Reference Value
The relative frequency display of the UPL shows the ratio between actual and nominal value.
The offset in ppm results from $(actualvalue/nominalvalue - 1) * 10^6$.

2.2.2.8 Phase Measurement

(see test report section 2.3.2, page 2.77)

Set UPL:

Analyzer	
Channel(s)	2 ≡ 1
Range	FIX: *)
FREQ/PHASE	PHASE
Unit	°

*) set according to test report

Measuring equipment:

UPD generator: sinewave 20 Hz – 22 kHz, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω.

Test setup: Connect the two outputs of the UPD generator to the two inputs of the UPL analyzer via XLR cable.

Measurement: Set generator and UPL analyzer and measure according to test report.
Input voltage $U_e = 0.75 *$ rated range value!
Read off the UPL phase difference display.

Note: This test only refers to the phase coincidence of the 2 channels. Thus proper functioning of the UPL hardware is ensured. The actual measuring accuracy of the phase is not tested — it is determined by the algorithm of the UPL program (type acceptance test performed in the factory!).

2.2.2.9 DC Measurement

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	*)
Range	FIX: *)
FUNCTION	DC
Unit	*)

*) set according to test report

The UPL analyzer is equipped with balanced (BAL) inputs for ranges from 100 mV to 30 V.
As quite a few internal range combinations are repeated, it is not necessary to measure all ranges (see also level table in section 1, page 4.3).
It is sufficient to test only the ranges 100 mV, 300 mV, 1 V, 3 V, 10 V and 30 V.

- DC offset

  (see test report section 2.3.2, page 2.78)

  Measurement: Set UPL analyzer according to test report.
  Internally terminate the inputs with low impedance → Impedance 300 Ω; no signal applied!
  Read off the actual value from the UPL display.

- DC measuring accuracy

  (see test report section 2.3.2, page 2.78)

Measuring equipment:

UPD generator: DC offset, Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND.
DC voltmeter

Test setup: Connect DC voltmeter to an output of the UPD generator: to this end, use adapter BNC socket to banana plug, adapter XLR plug to BNC socket and XLR cable.
Connect the XLR input of the UPL to be tested to the other output of the UPD generator via an XLR cable.

Measurement: Set UPD generator and UPL analyzer (→ Impedance 200 kΩ) and measure according to test report.
Measure the actual value of the input voltage using the DC voltmeter.
Reference is the measured voltage: → enter as reference for CH1 and CH2 in the analyzer panel.
Read off the UPL display ΔU in % for each channel.

Note: This is a stringent test for ensuring correct functioning of the UPL analyzer. The measurement results are no concrete data sheet values, but implicitly included in their error limits!

2.2.2.10 Distortion Factor THD

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	THD

*) set according to test report

- Measuring accuracy THD ≥ –60 dB (see test report section 2.3.2, page 2.80)

Measuring equipment:

UPD generator: Channel(s) 2 ≡ 1, Output BAL, Impedance 10 Ω, Common GROUND, Low Dist OFF

Note: The UPD generator generates the complete signal with multisine: Fundamental and one harmonic with different level

Test setup: Connect the XLR input of the UPL to be tested to the output of the UPD generator via XLR cable.

Measurement: Set UPD generator and UPL analyzer according to test report.
Additional UPL analyzer setting:
THD → Meas Mode → SELECT di → d2
Read off the UPL-THD display in dB.

- Measuring accuracy THD < –60 dB (see test report section 2.3.2, page 2.80)

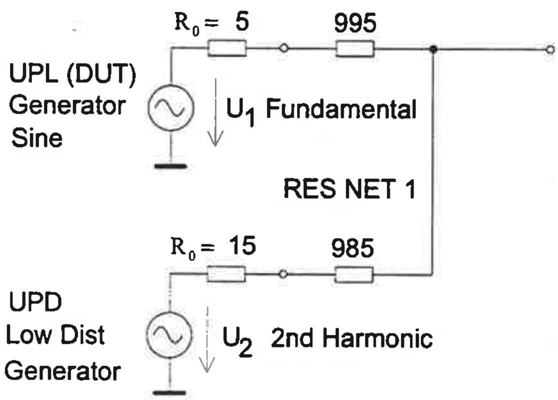
NOTE:

This test assumes that the analog generator of the UPL has been calibrated with respect to level and frequency.

Measuring equipment:

UPD Low Distortion Generator
UPL generator (DUT)
Resistance network with 985 Ω and 995 Ω

Signal generation:



Fundamental: → UPL generator (DUT).
Setting: Output UNBAL, Low Dist OFF, FREQUENCY → fundamental, VOLTAGE → 4 V
Harmonic: → from the UPD low distortion generator, a sinewave signal is added with 0 dB attenuation.
Setting: Output UNBAL, Impedance 15 Ω, Common GROUND
FREQUENCY → harmonic $d2 = 2{*}f_{GenUPL}$, Setting PRECISION, VOLTAGE → Level d2 in dBr, Ref Volt → 4 V = Reference fundamental

Test setup: Connect the XLR input of the UPL to be tested via adapter XLR plug/BNC to the resistance network and connect the latter to the outputs of the two generators via BNC cable.

Measurement: Set generators and UPL analyzer and measure according to test report.
Additional UPL analyzer setting:
Range FIX 3 V, THD → Meas Mode → SELECT di → d2
Read off the THD-d2 display in dB:
Worst case out of 5 measurements is test result.

- Notch filter frequency response

(see test report section 2.3.2, page 2.81)

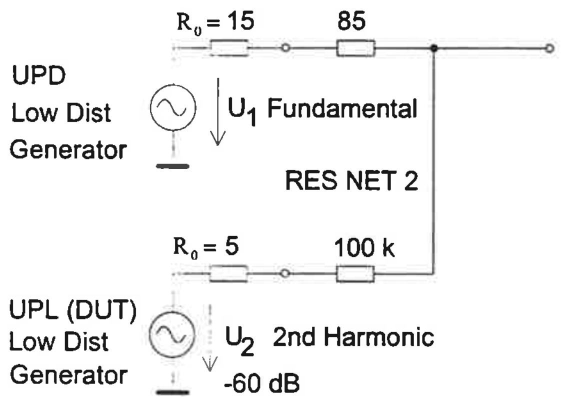
NOTE

This test assumes that the low distortion generator of the UPL has been calibrated with respect to level and frequency.

Measuring equipment:

UPD Low Distortion Generator
UPL Low Distortion Generator (DUT)
frequency counter
Resistance network with 85 Ω and 100 kΩ

Signal generation:



Fundamental: → UPD Low Distortion Generator .
Setting: Output UNBAL, Impedance 15 Ω, Common GROUND FREQUENCY → fundamental, Setting PRECISION, VOLTAGE → 2 V
Harmonic: → from the UPL generator (DUT), a sinewave signal with an attenuation of 60 dB is added.
Setting: Output UNBAL
FREQUENCY — harmonics $d2 = 2*f_{GenUPL}$,
VOLTAGE — level d2 = 0 dBr, Ref Volt → 2 V = Reference fundamental

Test setup: Connect the XLR input of the UPL to be tested via adapter XLR plug/BNC to the resistance network and connect the latter to the outputs of the two generators (to this end, use BNC cable for UPD generator; adapter XLR socket to BNC socket and BNC cable for UPL generator).
Connect the frequency counter to the other output of the UPL generator (to this end, use BNC cable and adapter XLR socket to BNC socket).

Measurement: Set generators and UPL analyzer and measure according to test report.
Measure the frequency of the harmonic d2 of the UPL generator using the frequency counter.
$\rightarrow f_{d2}$
Additional UPL analyzer setting:
INSTRUMENT ANLG 110kHz, Range FIX 3 V,
THD Meas Mode → SELECT di → d2
Enter in the analyzer panel for
THD Fundamentl → VALUE = (testfrequency f_{d2})/2.
Read off the THD-d2 display in dB. Form the difference to the nominal value –60 dB.

- Inherent distortion THD

  (see test report section 2.3.2, page 2.81)

NOTE

This test only makes sense if the THD measuring accuracy has been calibrated before, confirming proper functioning of the internal analog notch filters and the postamplification factors (see pages 2.30 and 2.32).

Measuring equipment:

UPD Low Distortion Generator: Output BAL, Impedance 30 Ω
Common GROUND,
FREQUENCY Setting PRECISION

Test setup: Connect the XLR input of the UPL to be tested to the output of the UPD generator via an XLR cable.

Measurement: Set UPD generator and UPL analyzer and measure according to test report.
Additional UPL analyzer setting:
THD → Meas Mode → All di
Read off the UPL THD display in dB

2.2.2.11 THD Inherent Distortion, Loop Generator-Analyzer

(see test report section 2.3.2, page 2.86)

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1
Output	*)
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:

Analyzer for THD: UPL (DUT)

Setting of UPL analyzer for:

22 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	AUTO
FUNCTION	THD
Meas Mode	All di
Dyn Mode	PRECISION
Unit	dB

100 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 110kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	AUTO
FUNCTION	THD
Meas Mode	All di
Dyn Mode	PRECISION
Unit	dB

NOTE:
The analyzer of the device under test must be used for this measurement, since the specifications in the data sheet apply to the sum inherent distortion of analyzer and generator.

Measurement: Further UPL setting and measurement according to test report.

2.2.2.12 Distortion Factor THD+N

(see test report section 2.3.2, page 2.86)
NOTE: This test only makes sense if the THD measuring accuracy has been calibrated before, confirming proper functioning of the internal analog notch filters and the postamplification factors. (see section 2.2.2.10, page 2.30 and 2.32).

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz *)
	ANLG 110kHz *)
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	THD+N/SINAD
FrqLim low	*)
FrqLim upp	*)

*) set according to test report

- Inherent distortion THD+N, Analyzer

Measuring equipment:

UPD generator: Channel(s) 2 ≡ 1, Output BAL, Impedance 30 Ω, Common GROUND, Low Dist ON

Test setup: Connect the XLR input of the UPL to be tested to the output of the UPD generator via an XLR cable.

Measurement: Set UPD generator and UPL analyzer according to test report. Read off the UPL THD+N display in dB.

2.2.2.13 THD+N Inherent Distortion, Loop Generator–Analyzer

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1
Output	*)
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:

Analyzer for THD+N: UPL (DUT)

Setting of UPL analyzer for:

22 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim Low	20.00 Hz
FrqLim Upp	21.90 kHz

100 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 110kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim low	150.00 Hz
FrqLim upp	100.00 kHz

NOTE:
The analyzer of the device under test must be used for this measurement, since the specifications in the data sheet apply to the sum inherent distortion of analyzer and generator.

Measurement: Further UPL setting and measurement according to test report.

2.2.2.14 Modulation factor MOD DIST

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz *)
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	MOD DIST

*) set according to test report

- Measuring accuracy MOD DIST < –60 dB

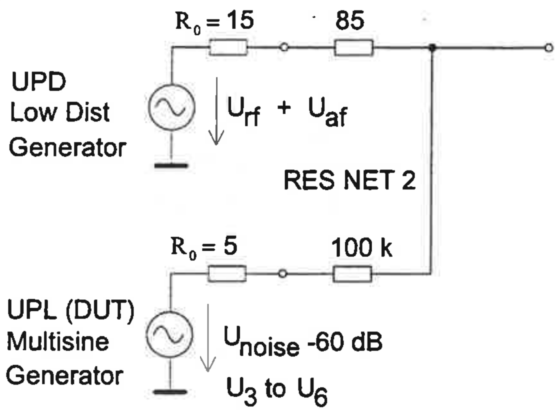
  (see test report section 2.3.2, page 2.91)

  NOTE: This test assumes that the analog generator of the UPL has been calibrated with respect to level and frequency.

  Measuring equipment:

  UPD Low Distortion Generator
  UPL generator (DUT):
  Resistance network with 85 Ω and 100 kΩ

Signal generation:



Mod Dist signal: → from UPD Low Distortion Generator
Setting: Output UNBAL, Impedance 15 Ω, Common GROUND
Low Dist ON, FUNCTION MOD DIST,
FREQUENCY → f_{rf} and f_{af}
Setting PRECISION
VOLTAGE → according to measurement instruction and test report.
Modulation lines: → UPL generator (DUT).
Setting: Output UNBAL, FUNCTION MULTISINE
FREQUENCY and VOLTAGE → according to table and formula.

No. of Sine	Frequency	Level
1	f_{af}	–140 dBr
2	f_{rf}	–140 dBr
3	f_{rf} - 2*f_{af}	U_3
4	f_{rf} - f_{af}	U_4
5	f_{rf} + f_{af}	U_5
6	f_{rf} + 2*f_{af}	U_6

$U_3 \ldots U_6$ in dBr
Reference for dBr is the level of f_{rf} → RefVolt = U_{rf}
$U_{rf} = 0.7$ V → $U_{eff} = 4.1231 * U_{rf} = 2.886$ V (without spurious modulation)

Test setup: Connect the XLR input of the UPL to be tested via adapter XLR plug /BNC to the resistance adapter and connect the latter via BNC cable to the outputs of the two generators (to this end, use BNC cable for UPD generator; adapter XLR socket to BNC socket and BNC cable for UPL generator).

Measurement: Set generators and UPL analyzer and measure according to test report.

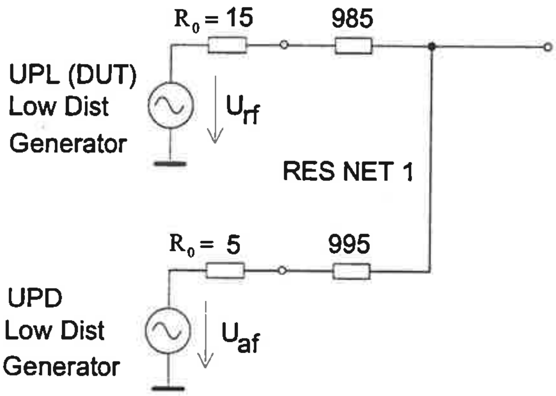
- Inherent distortion MOD DIST

(see test report section 2.3.2, page 2.92) NOTE: This test assumes that the generator of the UPL has been calibrated with respect to level and frequency.

Measuring equipment:

UPD Low Distortion Generator
UPL Low Distortion Generator (DUT)
Resistance network with 985 Ω and 995 Ω

Signal generation:



Sinewave U_{rf}: → from UPD Low Distortion Generator
Setting: Instrument ANLG 110kHz, Output UNBAL, Impedance 15 Ω, Common FLOAT, Low Dist ON, FUNCTION SINE, FREQUENCY → f_{rf}, Setting PRECISION
VOLTAGE → according to measurement instruction and test report.
Sinewave U_{af}: → UPL Low Distortion Generator (DUT).
Setting: Output UNBAL, FUNCTION SINE,
FREQUENCY and VOLTAGE → according to formula and test report.
RMS value of the complete signal at the output of the resistance network $U_a = U_{rms}$ from U_{rf} and U_{af}. The ratio U_{af}/U_{rf} is 4:1. Set this ratio via the generator levels.

$U_{rf} = \left[\frac{U_{eff}}{\sqrt{2}}\right]$ and

$U_{af} = \left[\frac{4*U_{eff}}{\sqrt{4.25}}\right]$

Test setup:

Connect the XLR input of the UPL to be tested via adapter XLR plug /BNC to the resistance network and connect the latter to the outputs of the two generators (to this end, use BNC cable for UPD generator; adapter XLR socket to BNC socket and BNC cable for UPL generator).

Measurement: Set generators and UPL analyzer and measure according to test report.
Set generator voltage, set frequency f_{rf}, vary frequency f_{af}
→ set new f_{rf}, vary f_{af}
→ set the next voltage
Read off the MOD DIST display in dB.

2.2.2.15 Difference-tone Factor DFD

Set UPD:

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Range	FIX: *)
FUNCTION	DFD
Meas Mode	*)

*) set according to test report

- Measuring accuracy DFD d2 and d3

  (see test report section 2.3.2, page 2.95)

Measuring equipment:

UPD generator

Signal generation:

UPD generator generates the complete signal with multisine
Setting: Output BAL, Impedance 30 Ω, Common FLOAT,
Function MULTISINE, Low Dist OFF
FREQUENCY and VOLTAGE → according to table and formula.

No. of Sine	Frequency	Level
1	f_1	–6 dBr
2	f_2	–6 dBr
3	f_3 = DiffFreq	U_3
4	$f_4 = f_1 - f_3$	U_4
5	$f_4 = f_1 + f_3$	U_5

f_1 = MeanFreq - DiffFreq/2
f_2 = MeanFreq + DiffFreq/2
$U_3 \ldots U_5$ in dBr
Reference for dBr is the level Ref Volt in the generator panel

Test setup: Connect the XLR input of the UPL to be tested to the output of the UPD generator via XLR cable.

Measurement: Set generators and UPL analyzer and measure according to test report. For checking the measuring accuracies DFD d2 and d3, set the analyzer to Range Fix 3 V and the measurement function to be tested, the generator to Ref Volt = 2 V and $U_4 = U_5 = -140$ dBr. Read off the display DFD d2 and d3, respectively, in dB.

- Inherent distortion DFD

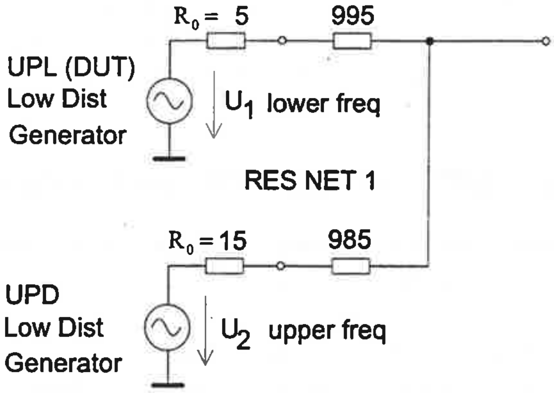
  (see test report section 2.3.2, page 2.97)

  NOTE: This test assumes that the generator of the UPL has been calibrated with respect to level and frequency.

  Measuring equipment:

  UPL Low Distortion Generator (DUT)
  UPD Low Distortion Generator
  Frequency counter
  Resistance network with 995 Ω and 985 Ω

Signal generation:



Sinewave U_1: → UPL Low Distortion Generator (DUT).
Setting: Output UNBAL, FUNCTION SINE
FREQUENCY → f_2
Sinewave U_2: → from UPD Low Distortion Generator
Setting: Output UNBAL, Impedance 15 Ω, Common FLOAT,
Low Dist ON, FUNCTION SINE, FREQUENCY → f_2
Setting PRECISION
The following is true for the generated voltages and frequencies:
$U_1 = U_2$
MeanFreq = $0.5 * (f_1+f_2)$ center frequency
f_1 = MeanFreq − DiffFreq/2
f_2 = MeanFreq + DiffFreq/2
The following is true for the complete signal U_a at the output of the resistance network:

RMS value = $0.7071*U_1$
peak value = $1.4142*U_1$ = 2* peak value

Test setup:

Connect the XLR input of the UPL to be tested via adapter XLR plug /BNC to the resistance network and connect the latter to the outputs of the two generators (to this end, use BNC cable for UPD generator, adapter XLR socket/BNC and BNC cable for the UPL generator). Connect a frequency counter to the second output of the UPL generator (to this end, use adapter XLR socket/BNC and BNC cable).

Measurement:

Set generators and UPL analyzer and measure according to test report.
Set generator voltages $U_1 = U_2 = U_{rms}/2$ and mean frequency with f_1 and f_2.
Read off the display DFD d2 or d3, respectively, in dB.

Note: When setting the test frequency of the UPL Low Distortion Generator, there may be problems with the frequency accuracy. Therefore, a subsequent measurement must be carried out using a frequency counter and, if necessary, a correction is to be performed!

2.2.3 Performance Test UPL-B1, Low Distortion Generator

Adaptation of the measuring instruments to the output of the generator is described in the Performance Test of the analog generator in section 2.2.1, page 2.11.

Before starting the test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE` → `Mode` → `DEF SETUP`.

2.2.3.1 Level Accuracy at 1kHz

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	ON
FREQUENCY	1.0000 kHz
VOLTAGE	*)

*) set according to test report

Measuring instrument:
AC voltmeter

Measurement: Connect AC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustments:
→ Level adjustment analog generator
→ LF adjustment lowpass 23 kHz
→ Automatic adjustment low distortion generator

2.2.3.2 Frequency Response

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:
AC voltmeter

Measurement: Connect AC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.
Relative display in dB, reference is the voltage measured at 1 kHz.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustment:
→ 100-kHz adjustment low distortion generator

2.2.3.3 Frequency Accuracy

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	1.0000 V

*) set according to test report

Measuring instrument:
Frequency counter

Measurement:
Connect frequency counter to output of UPL generator.
To this end, an adapter XLR female to BNC female is required.
Further UPL setting and measurement according to test report.

NOTE:
This test is affected by the following adjustment:

→ Automatic adjustment low distortion generator

2.2.3.4 THD Inherent Distortion

Measurement procedure:

In the audio frequency range, the harmonics suppression of the UPL generator is typ. 115 dB to 125 dB, depending on the set frequency. The UPL analyzer features about the same harmonics suppression so that the inherent distortions of the generator cannot be directly checked using the UPL analyzer; the UPD analyzer or another analyzer available on the market cannot be used either. With the measurement function FFT, the UPD analyzer features a dynamic range of >100 dB. For measuring the harmonics suppression of the UPL generator, a passive notch filter is used, suppressing the fundamental by more than 60 dB, but attenuating the harmonics by less than 10 dB. This results in an increase of the dynamic range by 50 dB from 100 dB to 150 dB, referred to the non-suppressed fundamental. The attenuation of the harmonics by the notch filter must be taken into account in the measurement. The attenuation factors are indicated with the circuit of the notch filter, see section 2.1, page 2.6.

The measurement is performed at the frequencies 20 Hz, 1 kHz, 7 kHz and 20 kHz with a level of 2.5 V and 10 V.

The following example describes the setting of the UPL generator, of the UPD analyzer and the measurement procedure for a signal frequency of 1 kHz with a level of 2.5 V. The deviating settings of the UPD at the frequencies 20 Hz, 7 kHz and 20 kHz are listed subsequently.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report (in this example 1 kHz, 2.5 V).

Measuring instrument:

FFT analyzer: UPD

Setting of the UPD analyzer for a signal frequency of 1 kHz:

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	1
Ch1 Input	UNBAL BNC
Common	FLOAT
Ch1 Range	AUTO
FUNCTION	FFT
Unit Ch1	dBr
Reference	VALUE: *)
FFT Size	8192
Window	RIFE VINC 2
Avg Mode	EXPONENTIAL
Avg Count	1
Zooming	OFF

Display	
OPERATION	SPECTRUM
TRACE A	FUNC CH1
Unit	V
Scale	MANUAL
Spacing	LOG
Top	100.00 µV
Bottom	0.0100 µV
X AXIS	FREQ
Scale	MANUAL
Spacing	LIN
Left	0.0000 Hz
Right	10.000 kHz

*) set according to generator voltage (in this example 2.5 V).

Test setup:

- ▷ Connect output of UPL generator to input of UPD analyzer. To this end, an adapter XLR female to BNC female is required.

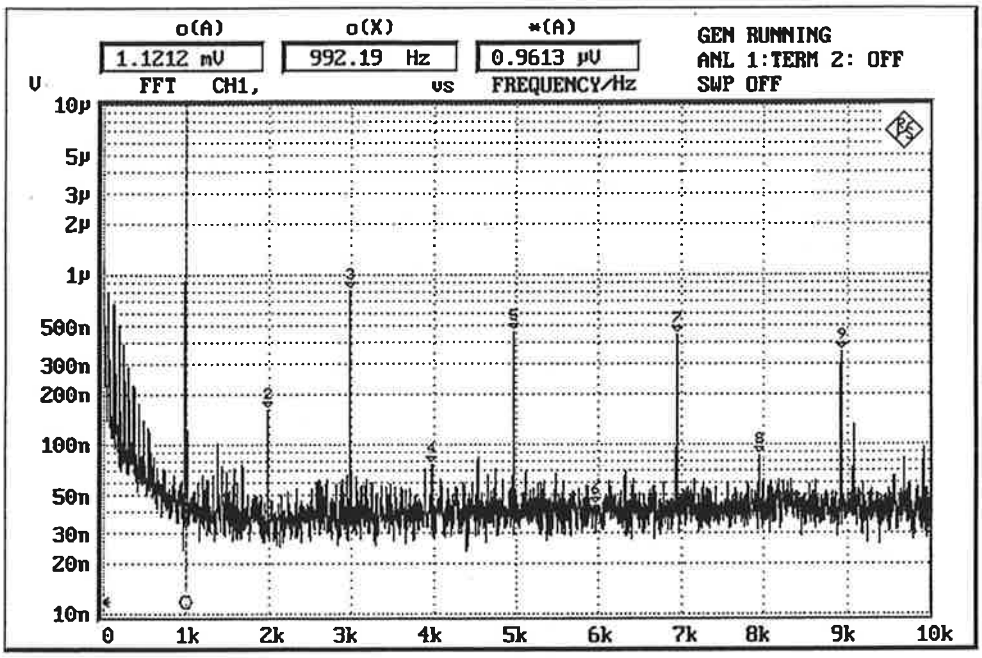
Preparation of the measurement:

- ▷ Press the [START] key to restart the measurement.
- ▷ The measured value displayed under RMS via FFT must be about 0 dBr.
- ▷ Connect the notch filter between the output of the UPL generator and the input of the UPD analyzer.
- ▷ In order to achieve a suppression of the fundamental of more than 60 dB it may be necessary to slightly readjust the generator frequency until the measured value RMS via FFT is < –60 dBr.

Measurement:

- ▷ Set Avg Count 8 in the Analyzer panel.
- ▷ Press the [GRAPH] key to change to full-screen graphics display.
- ▷ Press the [SINGLE] key to terminate the measurement. This is indicated by means of ANL 1:TERM 2: OFF in the second status line at the top right of the screen.
- ▷ For operating the graphics functions, the softkeys at the lower edge of the screen are used. If the lefthand softkey is labelled [BACK], press it twice to return to the main menu.
- ▷ Softkeys: [MARKER] → [TRACE A] → [MAX] → [HARM].
  The harmonics d_2 to d_9 are now marked by small triangles with numbers from 2 to 9.
- ▷ Softkeys: [BACK] → [BACK] → [o CURSOR] → [SET TO] → [MARKER].
  The o CURSOR is positioned at the fundamental (about 1 kHz).

Approximately the following picture should be displayed now:



- ▷ Press the softkey NEXT HARM. The cursor jumps to the next harmonic d_2. The voltage of this harmonic is displayed in the display field below o(A).
- ▷ Measure the voltage of each harmonic d_n (n = 2 to 5) using the cursor ($\rightarrow U_{dn}$) and correct with the attenuation a_n of the notch filter (the attenuations a_n are indicated with the circuit of the notch filter, see section 2.1, page 2.6). Thus the following voltage of the nth harmonic is obtained:

$$U_n = U_{dn} * a_n$$

- ▷ Calculation of the THD measurement result:
  Squarelaw addition of the individual harmonics:

$$U_{THD} = \sqrt{\sum_{n=2}^{5} U_n{}^2}$$

Reference to the fundamental:

$$THD = 20 * \log \frac{U_{THD}}{U_1} \quad (in \quad dB)$$

where U_1 is the voltage set in the UPL generator (in this example 2.5 V).

Evaluation of the measurement for this example:

- ▷ Read off the values for U_{dn} in the above illustration. Multiplication by a_n results in the real value of the harmonics U_n.

n	U_{dn}	a_n	U_n
2	160 nV	2.85	0.456 μV
3	850 nV	1.8	1.530 μV
4	—	1.5	—
5	470 nV	1.3	0.611 μV
6	—	1.2	—
7	450 nV	1.16	0.522 μV

▷ The harmonics d_2 to d_5 are dominant.
The harmonics $> d_5$ can be neglected.

$$U_{THD} = \sqrt{\sum_{n=2}^{5} {U_n}^2} = 1.71\mu V$$

$$THD = 20 * \log \frac{U_{THD}}{U_1} = 20 * \log \frac{1.71\mu V}{2.5V} = -123.3dB$$

▷ If, in addition, d_7 with $U_n = 0.522\mu V$ was taken into account, the following would result:

$$U_{THD} = 1.79\mu V$$

and thus

$$THD = 20 * \log \frac{1.79\mu V}{2.5V} = -122.9dB$$

Setting of the UPD analyzer for other frequencies:

20 Hz

Analyzer	
INSTRUMENT	ANLG 22kHz
ZOOMING	ON (2..256)
Center	1 kHz
Span	5.48 kHz

Display	
OPERATION	SPECTRUM
X-AXIS	
Right	200.00 Hz

1 kHz

Analyzer	
INSTRUMENT	ANLG 22kHz
ZOOMING	OFF

Display	
OPERATION	SPECTRUM
X-AXIS	
Right	10.000 kHz

7 kHz

Analyzer	
INSTRUMENT	ANLG 100kHz
ZOOMING	OFF

Display	
OPERATION	SPECTRUM
X-AXIS	
Right	70.000 kHz

20 kHz

Analyzer	
INSTRUMENT	ANLG 300kHz
ZOOMING	OFF

Display	
OPERATION	SPECTRUM
X-AXIS	
Right	200.00 kHz

2.2.3.5 THD+N Inherent Distortion

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	*)
FUNCTION	SINE
Low Dist	ON
FREQUENCY	*)
VOLTAGE	*)

*) set according to test report

Measuring instrument:

Analyzer for THD+N: UPD

Setting of the UPD analyzer for:

22 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	1
Ch1 Input	*)
Ch1 Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim Low	20.00 Hz
FrqLim Upp	21.90 kHz

100 kHz test bandwidth	
Analyzer	
INSTRUMENT	ANLG 110kHz
Channel(s)	1
Ch1 Input	sf *)
Ch1 Range	AUTO
FUNCTION	THD+N/SINAD
Dyn Mode	PRECISION
Unit	dB
FrqLim low	150.00 Hz
FrqLim upp	100.00 kHz

*) set according to UPL generator Output,
Input BAL with impedance 20 kΩ.

Test setup: Connect UPD analyzer to output of UPL generator
Output BAL: Use balanced cable (XLR).
Output UNBAL: Use adapter XLR female to BNC female and an unbalanced cable (BNC).

Measurement: Further UPL setting and measurement according to test report.

2.2.4 Performance Test UPL-B2, Digital Audio I/O

Before starting the test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
LOAD INSTRUMENT STATE → Mode → DEF SETUP.
For testing the rated specifications of the Option UPL-B2 it is recommended to use the following test procedure:

2.2.4.1 Digital Generator

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	AUDIO DATA
Channel(s)	2 = 1
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	VALUE: 48000 Hz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Audio Bits	20
Unbal Vpp	see measurement
Bal Vpp	see measurement
FUNCTION	SINE
FREQUENCY	991.00 Hz
VOLTAGE	0.5000 FS

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	AUDIO DATA
Channel(s)	BOTH
Input	see measurement
Sync To	AUDIO IN
Sample Frq	48 kHz
Audio Bits	20
START COND	AUTO
Delay	0.0000 s
FUNCTION	THD+N/SINAD
Meas Mode	THD+N
Rejection	NARROW
Unit	dB
Filter	OFF
Fnct Settl	OFF

- Level accuracy of the UNBAL output

Measuring instrument:

oscilloscope

Measurement: Connect the oscilloscope to the UNBAL output of the UPL via a 75-Ω cable and a 75-Ω termination.
Level setting and measurement according to test report.

Adjustment: The level of the UNBAL or BAL output can be adjusted using potentiometer R13 (TX AMPL) on the front panel module of the Option UPL-B2, if necessary.

- Level accuracy of the BAL output

Measuring instrument:

Oscilloscope with probe 10:1

Measurement: In order to facilitate matching of the balanced output to the unbalanced input of the oscilloscope, the open-circuit voltage of the BAL output is measured using a high-impedance probe and without termination.
Connect the oscilloscope with probe (BNC) and XLR/BNC adapter to the BAL output of the UPL.
Level setting and measurement according to the test report.

Note: If the option UPL-B22 is available, the input pulse amplitude of the digital signals can be directly measured. The easiest way of checking the level accuracy is to proceed according to the respective chapter of the option UPL-B22.

- Frequency accuracy of the internal clock rate

Measuring instrument:

Frequency counter

Measurement: Connect frequency counter to SYNC output of UPL.
Setting of clock rate and measurement according to the test report.

- External generator synchronization

Additional UPL settings:

Generator: SYNC To → SYNC IN
Sync Mode → WORD CLK
Sync Out → SYNC PLL
Type → WORD CLK

Measuring instrument:

Frequency counter
TTL clock generator 27...55 kHz

Measurement: Connect frequency counter to SYNC output of UPL
Connect TTL clock generator 27...55 kHz to SYNC IN
Compare the set clock rate on the external generator with the display on the frequency counter.

- Digital signal generation

Note: The digital signal generation is accomplished by respective programming of the signal processor. Proper functioning should be checked by means of a loop measurement using the digital analyzer. (See also section function testing, chapter 5.1.1, page 5.1)

2.2.4.2 Digital Analyzer

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	AUDIO DATA
Channel(s)	2 = 1
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	VALUE: 48000 Hz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Audio Bits	24
Unbal Vpp	0.1000 V
Bal Vpp	0.4000 V
FUNCTION	SINE
FREQUENCY	991.00 Hz
VOLTAGE	1.0000 FS

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	AUDIO DATA
Channel(s)	BOTH
Input	see measurement
Sync To	AUDIO IN
Sample Frq	48 kHz
Audio Bits	24
START COND	AUTO
Delay	0.0000 s
FUNCTION	THD+N/SINAD
Meas Mode	THD+N
Rejection	NARROW
Unit	dB
Filter	OFF
Fnct Settl	OFF

- Testing the digital inputs

Test: Connect the individual digital inputs of the UPL (BAL, UNBAL, OPTICAL) one after the other to the corresponding digital output of the UPL.
Select the input to be tested on the analyzer (Input).
Compare the measured values for Input PEAK and Frequency displayed on the analyzer with the settings on the generator.
Setting and measurement according to the test report.

- Test functions

Note: The complete test functions of the digital analyzer are determined by programming the analyzer DSP. Function testing of the hardware can therefore be restricted to a striking test function. The loop measurement simultaneously checks the digital generator and proper functioning of the DSP algorithms.

Test setup: Connect the digital analyzer input to the digital generator output (INTERN, BAL, UNBAL or OPTICAL).

Measurement: Perform THD+N measurement (function THD+N/SINAD) and compare measured values with test report.

2.2.5 Performance Test UPL-B21 (Protocol Analysis)

Before starting the test, set the UPL to a defined initial status. To this end, call the default setting in the FILE Panel under the menu item LOAD INSTRUMENT STATE → Mode → DEF SETUP.

For checking the rated specifications of the option UPL-B21 it is recommended to use the following test procedure:

Note: The digital protocol generation is accomplished by respective programming of the interface devices. To check proper functioning of the protocol generator and the correct display of the protocol analyzer, a loop measurement of generator and analyzer is used.

2.2.5.1 Professional Format

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	AUDIO DATA
Channel(s)	2 = 1
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	VALUE: see measurement
Sync Out	GEN CLK
Type	WORD CLK
Unbal Vpp	1.000 V
PROTOCOL	ENHANCED
Valid Chan	1 & 2
Ch Stat. L	PANEL+AES3
Ch Stat. R	EQUAL L
User Mode	ZERO
Panelname	R&S_AES3.PP

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	AUDIO DATA
Channel(s)	BOTH
Input	see measurement
Sync To	AUDIO IN
Sample Frq	48 kHz
Audio Bits	20
START COND	AUTO
Delay	0.0000 s
INPUT DISP	PEAK
FREQ/PHASE	SAMPLE FREQ
FUNCTION	PROTOCOL

- Channel status and user data

  Test setup: Connect digital analyzer input to digital generator output (INTERN, BAL, UNBAL or OPTICAL).

  Test: Compare the status and user data displayed on the analyzer protocol window with the settings on the generator.

- Clock rate measurement

  Measuring instrument:

  Frequency counter

Test setup: Connect digital analyzer input to digital generator output (INTERN, BAL, UNBAL or OPTICAL).
For the clock rate measurement connect frequency counter to SYNC OUT.

Measurement: Set the sampling rate on the generator according to the test report and compare the measured values displayed on the analyzer protocol window with the display on the frequency counter.
Maximum frequency offset according to test report.

2.2.5.2 Consumer Format

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	AUDIO DATA
Channel(s)	2 = 1
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	VALUE: see measurement
Sync Out	GEN CLK
Type	WORD CLK
Unbal Vpp	1.000 V
PROTOCOL	ENHANCED
Valid Chan	1 & 2
Ch Stat. L	PANEL+CRC
Ch Stat. R	EQUAL L
User Mode	ZERO
Panelname	R&S_CONS.PP

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	AUDIO DATA
Channel(s)	BOTH
Input	see measurement
Sync To	AUDIO IN
Sample Frq	48 kHz
Audio Bits	20
START COND	AUTO
Delay	0.0000 s
INPUT DISP	PEAK
FREQ/PHASE	SAMPLE FREQ
FUNCTION	PROTOCOL

- Channel status and user data

Test setup: Connect digital analyzer input to digital generator output (internal, BAL, UNBAL or OPTICAL).

Test: Compare the status and user data displayed on the analyzer protocol window with the settings on the generator.

2.2.6 Performance Test UPL-B22 (Jitter/Interface test)

Before starting the test, set the UPL to a defined intial status. To this end, call the default setting in the FILE Panel under the menu item LOAD INSTRUMENT STATE → Mode → DEF SETUP.

For testing the rated specifications of the Option UPL-B22 it is recommended to use the following test procedure:

Note: For testing the individual functions of the generator as well as the measurement functions of the analyzer a loop measurement is performed. Thus the number of measuring instruments required for testing is reduced.

2.2.6.1 Common-mode Operation

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	COMMON MODE
Unbal Out	AUDIO OUT
Cable Sim	see measurement
Sync To	GEN CLK
Sample Frq	48 kHz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Unbal Vpp	see measurement
FUNCTION	SINE
FREQUENCY	see measurement
VOLTAGE	see measurement

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	COMMON MODE
Input	see measurement
START COND	AUTO
Delay	0.0000 s
INPUT DISP	PEAK
FREQ/PHASE	see measurement
FUNCTION	RMS & S/N
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

- Level measurement of the UNBAL input

Measurement: Set analyzer input to UNBAL.
Connect UNBAL output of the UPL to the UNBAL input (75-Ω cable) and compare the display of the measured level on the UPL with the set generator level.
Level setting and measurement according to test report.

- Level measurement of the BAL input

Measurement: Set analyzer input to BAL.
Connect BAL output of the UPL to BAL input (XLR cable) and compare the display of the measured level on the UPL with the set generator level.
Level setting and measurement according to test report.

- Common-mode amplitude

Measurement: Set analyzer input to BAL.
Connect the BAL output of the UPL to the BAL input (XLR cable) and compare the display of the measured common-mode amplitude at 1 kHz with the common-mode amplitude set on the generator.
Setting of common-mode amplitude and measurement according to test report.

- Common-mode frequency response

Measurement: Set analyzer input to BAL.
Connect BAL output of UPL to BAL input (XLR cable).
Setting of the common-mode frequency and amplitude measurement according to test report.
If installed, the low-distortion generator (UPL-B1) is used.
In this case, the frequency response can be measured up to 100 kHz.

- Sampling rate

Measuring instrument:
Frequency counter

Measurement: For the clock rate measurement, connect the frequency counter to SYNC OUT.
Set the sampling rate on the generator according to the test report and compare the measured values displayed on the analyzer protocol window with the display on the frequency counter.
Maximum frequency offset according to test report.

- Cable simulator

Measuring instrument:
Oscilloscope

Test setup: Connect the oscilloscope to the UNBAL output of the UPL via a 75-Ω cable and a 75-Ω termination.
Connect the BAL output of the UPL to the BAL input (XLR cable).

Measurement: UNBAL output:
Switch on the cable simulator in the generator menu and check the pulse shape of the digital signal at the output.
If the cable simulator is switched on, the rise time of the digital signal is clearly reduced at the UNBAL output.
The increase is very flat in the 90% range so that a large measurement tolerance is to be taken into account here.
Compare the rise time with the values in the test report.

Measurement: BAL output:
Set UNBAL Out to AUDIO IN in the generator menu.
Thus the UPL input signal (BAL) is output again at the UNBAL output so that it can be examined on the oscilloscope.
If the cable simulator is switched on, the rise time of the digital signal is clearly reduced at the BAL output, which is now applied to the oscilloscope via the UNBAL output.
The increase is very flat in the 90% range so that a large measurement tolerance is to be taken into account here.
Compare the rise time with the values in the test report.

2.2.6.2 Input/Ref phase shift

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	PHASE
PhaseToRef	see measurement
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	48 kHz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Unbal Vpp	1.0000 V
FUNCTION	SINE
FREQUENCY	1000.0 Hz
VOLTAGE	0.5000 FS

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	BAL (XLR)
Jitter Ref	GEN CLK
START COND	AUTO
Delay	0.0000 s
INPUT/PHAS	PHAS TO REF
FREQ/PHASE	SAMPLE FREQ
FUNCTION	RMS & S/N
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

- Generator phase shift and measurement

Adjustment: Perform the PhaseToREF adjustment in the OPTIONS Panel under CALIBRATION DIG.
The phase generation and the phase measurement are thus adjusted.

Test setup: Connect the digital analyzer input to the digital generator output (internal, BAL, UNBAL or OPTICAL).
Connect REF IN to REF OUT at the rear of the UPL.

Measurement: Vary the Frame Phase on the generator and compare with the measured display on the UPL analyzer.
Phase setting and measurement according to test report.

Note: When using long cable connections of the respective inputs/outputs, an additional measurement uncertainty is involved. Therefore, XLR cables of the same length should be used between digital input/output and REF input/output with a maximum length of approx. 5m.
Measured values with ±50% Frame Phase are not unambiguous so that a positive or negative value can be displayed here.

2.2.6.3 Jitter Generation and Measurement

Jitter measurement with generator and analyzer

Note: The individual functions of the generator and the measurement functions of the analyzer are checked by means of a loop measurement. Thus the number of measuring instruments required is reduced.
A modulation analyzer for phase modulation can be used for checking the measurement results of the jitter analyzer. It must be capable of measuring a phase deviation (peak value) of at least $\pm 1\pi$ (± 3.14 rad) at 6.144 MHz.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	JITTER
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	see measurement
Sync Out	see measurement
Type	BIPHASE CLK
Ref Out	see measurement
Audio Bits	20
Unbal Vpp	1.0000 V
FUNCTION	SINE
Low Dist	see measurement
Jitt Freq	see measurement
JittPkAmpl	see measurement

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	see measurement
Jitter Ref	see measurement
INPUT/PHASE	PEAK
FREQ/PHASE	FREQ
START COND	AUTO
Delay	0.0000 s
FUNCTION	RMS & S/N
Meas Time	AUTO
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

- Jitter amplitude

Measuring instruments:

Modulation analyzer for phase modulation (for checking the measured values).

Test setup: Connect the digital analyzer input to the digital generator output (INTERN, BAL, UNBAL or OPTICAL).
Connect the modulation analyzer to SYNC OUT.

Measurement: Vary the jitter frequency on the generator and compare with the Jitter Input Peak display on the analyzer.
Measurement at the standard sampling rates (32 kHz, 44.1 kHz and 48kHz) with respective sync PLL of the analyzer as jitter reference.
Measurement at variable sampling rates 27 kHz...55 kHz with internal generator (REF GEN as jitter reference).
Switch off weighting filter during jitter measurement.
Generator setting and measurement according to test report.

Adjustment: The jitter amplitude can be adjusted using potentiometer R246 (TX Jitter) on the AES main board of the option UPL-B2, if necessary.

Note: A jitter amplitude of 0.5 UI (peak) corresponds to a modulation deviation of 3.14 rad (peak) of the bi-phase clock applied to SYNC OUT and which can be used for measurement of the modulation analyzer.
To this end, set the SYNC output to AUDIO IN and Type to BIPHASE CLK in the Generator menu.

- Jitter frequency response

Measurement: Vary the jitter frequency on the generator and compare with the Jitter Input Peak display on the analyzer.
When using the built-in low-distortion generator, the frequency response can be measured up to 100 kHz.
Measurement at the standard sampling rates (32 kHz, 44.1 kHz and 48 kHz) with the respective sync PLL of the analyzer.
Measurement at variable sampling rates 27 kHz...55 kHz with internal generator (REF GEN as jitter reference)
Generator setting and measurement according to the test report.

Note: When using the VARI PLL as jitter reference of the analyzer, the additional jitter component must be taken into account in the measurement due to the inherent jitter and the larger PLL bandwidth.
Usage of this PLL is to be recommended only if the test item is not to be operated with the generator of the UPL and with variable sampling rate.

- Reclock function

Note: The input signal featuring jitters is sampled with a low-jitter clock from the reference PLL and output again at the REF OUT. With the standard sampling rates (32 kHz, 44.1 kHz and 48 kHz), the respective reference PLL should be used for the jitter measurement.
The reclock function can be used for jitter amplitudes of up to 0.15UI (peak).

Test setup: Connect the digital analyzer input to the digital generator output (INTERN, BAL, UNBAL or OPTICAL).
Connect oscilloscope to XLR/BNC adapter and BNC probe to REF OUT.
Apply oscilloscope trigger to SYNC OUT.

Additional UPL settings:

Generator: Sync Out: SYNC PLL
Type: BIPHASE CLK
REF Out: AUDIO IN RCLK

Measurement: Set sampling rate, jitter amplitude and jitter frequency on the generator according to the test report.
Examine the digital signal at the REF output on the oscilloscope.
The signal shown on the oscilloscope must not contain any jitter. For checking purposes, set the REF output to AUDIO IN in the generator menu in order to view the input signal featuring jitters on the oscilloscope.

Adjustment: The correct phase position for sampling with the low-jitter clock can be adjusted using potentiometer R249 (RECLOCK PHASE) on the AES main board of the Option UPL-B2.

2.2.7 Performance Test UPL-B5, Audio Monitor

Before starting the test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP`.

Set UPL:

Generator	
VOLTAGE	1.0000 V

Analyzer	
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 1.0 V RMS
SPEAKER	INPUT CH1&2
Phone Out	see test

2.2.7.1 Function Test

For checking the specifications (analog) of the option UPL-B5, it is recommended to proceed according to the following test sequence:

- Function of the phone jack

  Phone Out =SPEAKER:

  When connecting external headphones, the internal loudspeaker must not be heard any longer.
  The [LOCAL] key acts on the internal loudspeaker and the connected headphones in the same way.

  Phone Out PERMANENT:

  The internal loudspeaker remains switched on irrespective of the connection of the headphones socket.
  The [LOCAL] key causes the internal loudspeaker to be switched off, the headphones output ,however, permanently remains active.

  When carrying out this function test, observe the sound and the volume of the internal loudspeaker. No distortions should be noticed and, when varying the frequency between 0.4, 1 and 10 kHz, there should be no discernible difference in the volume.

- Switchover of signal source

  Set the generator output to:

  Channel(s) 1 — A tone may be heard only from the right earpiece of the headphones (not from the left one because of the setting GEN CROSSED)

  Channel(s) 2 — A tone may be heard only from the left earpiece of the headphones.

  Channel(s) 2≡1 — A tone of the same volume must be heard from both earpieces.

The same test is to be carried out when setting the digital instrument (digital generator and digital analyzer).

Set UPL:

Generator	
INSTRUMENT	DIGITAL
VOLTAGE	1.0000 FS
Sample Frq	VALUE: see test lock-in range of the PLL

Analyzer	
INSTRUMENT	DIGITAL
Channel(s)	BOTH
Input	INTERN
SPEAKER	DIG CH1&2

- Switchover of signal source

  Set the generator output to:

  Channel(s) 1 — A tone may be heard only from the left earpiece of the headphones

  Channel(s) 2 — A tone may be heard only from the right earpiece of the headphones.

  Channel(s) 2≡1 — A tone of the same volume must be heard from both earpieces.

- Lock-in range of the PLL

  For this test, the previously selected setting (digital domain) is maintained and the audio clock is changed in the generator panel. Set the following clock frequencies (Sample Frq): 27, 41 and 55 kHz. The tone generated by the audio monitor must always sound the same irrespective of the clock rate.

  Since the analyzer is not changed in terms of the clock rate, the signal frequency measured in this test varies inversely with respect to the clock rate (referred to 48 kHz).

2.2.7.2 Checking the Specifications

For carrying out the following tests of the UPL-B5, it is recommended to use the "analog" setting (as described at the beginning of this section).
For checking the specifications, it is advisable to use an appropriate audio analyzer. For sequential measurement of the two channels, it is possible to use the other UPL channel by connecting the headphones output to the analyzer inputs (for this purpose, the adapter 6.3mm jack connector to BNC/XLR is used, see section 2.1, page 2.3). An external analyzer or distortion meter is to be used only for testing the inherent distortions in the digital domain.

- Testing the output voltage
- Frequency response of the headphones output
- Inherent distortions THD+N at the headphones output (analog domain)
- Inherent distortions THD+N at the headphones output (digital domain)

2.3 Test Report

2.3.1 Performance Test Report of Analog Generator

Audio Analyzer UPL **Rohde & Schwarz**

UPL / Analog Generator

Order No. 1078.2008

Date: . . . .

Serial No.: . . . .

Name: . . . .

measurement		min	act.	max	unit
Sine Level Accuracy at 1 kHz					
Channel(s)	1				
Output	UNBAL				
Voltage	8.0000 V	7.9200		8.0800	V
	4.0000 V	3.9600		4.0400	V
	2.0000 V	1.9800		2.0200	V
	1.0000 V	0.9900		1.0100	V
	0.5000 V	0.4950		0.5050	V
	0.2500 V	0.2475		0.2525	V
	15.000 mV	14.850		15.150	mV
Channel(s)	1				
Output	BAL				
Impedance	10 Ω				
Voltage	16.000 V	15.840		16.160	V
	2.0000 V	1.9800		2.0200	V
	0.5000 V	0.4950		0.5050	V
Channel(s)	2				
Output	UNBAL				
Voltage	2.0000 V	1.9800		2.0200	V
Channel(s)	2				
Output	BAL				
Impedance	10 Ω				
Voltage	4.0000 V	3.9600		4.0400	V
Sine Frequency Response UNBAL					
Channel(s)	1				
Output	UNBAL				
Voltage	2.000 V				
Frequency	10 Hz	−0.1		0.1	dB
	20 Hz	−0.05		0.05	dB
	50 Hz	−0.05		0.05	dB
	100 Hz	−0.05		0.05	dB
	200 Hz	−0.05		0.05	dB

- continued -

measurement		min	act.	max	unit
	500 Hz	−0.05		0.05	dB
	1 kHz	0		0	dB
	2 kHz	−0.05		0.05	dB
	5 kHz	−0.05		0.05	dB
	10 kHz	−0.05		0.05	dB
	20 kHz	−0.05		0.05	dB
Voltage	0.250 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Voltage	0.500 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Voltage	1.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Voltage	4.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Voltage	8.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Channel(s)	2				
Output	UNBAL				
Voltage	2.000 V				
Frequency	20 Hz	−0.05		0.05	dB
	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Sine Frequency Response BAL					
Channel(s)	1				
Output	BAL				
Impedance	10 Ω				
Voltage	2.000 V				
Frequency	10 Hz	−0.1		0.1	dB
	20 Hz	−0.05		0.05	dB
	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Voltage	0.500 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Channel(s)	2				
Output	BAL				
Impedance	10 Ω				
Voltage	2.000 V				
Frequency	20 Hz	−0.05		0.05	dB

- continued -

measurement		min	act.	max	unit
	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
Sine Frequency Accuracy					
Frequency	1.00000 kHz	0.99995		1.00005	kHz
DC Offset 0 V: Residual DC					
Output	UNBAL				
Voltage	8.0000 V	−80		80	mV
	4.0000 V	−40		40	mV
	0.5000 V	−5		5	mV
Output	BAL				
Impedance	10 Ω				
Voltage	1.0000 V	−10		10	mV
DC Offset: Accuracy					
Output	UNBAL				
DC Offset	1.0000 V	0.98		1.02	V
	−1.0000 V	−1.02		−0.98	V
Output	BAL				
Impedance	10 Ω				
DC Offset	2.0000 V	1.96		2.04	V
	−2.0000 V	−2.04		−1.96	V
THD+N Inherent Distortion					
Output	UNBAL				
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	20 Hz			−94	dB
	2 kHz			−94	dB
	10 kHz			−94	dB
	20 kHz			−94	dB
Voltage	2.5000V				
Frequency	2 kHz			−94	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	2 kHz			−86	dB
	10 kHz			−86	dB
	20 kHz			−86	dB
Voltage	2.5000V				
Frequency	2 kHz			−86	dB
Output	BAL				
Impedance	10Ω				
Analyzer Bandwidth	*22 kHz*				
Voltage	20.000V				
Frequency	20 Hz			−94	dB
	2 kHz			−94	dB
	10 kHz			−94	dB

- continued -

measurement		min	act.	max	unit
	20 kHz			–94	dB
Voltage	5.0000V				
Frequency	2 kHz			–94	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	20.000V				
Frequency	2 kHz			–86	dB
	10 kHz			–86	dB
	20 kHz			–86	dB
Voltage	5.0000V				
Frequency	2 kHz			–86	dB
MOD DIST Inherent Distortion					
Lower Freq	60 Hz				
Upper Freq	4 kHz			–84	dB
	7 kHz			–94	dB
	10 kHz			–84	dB
	20 kHz			–84	dB
DFD Level Accuracy					
Mean Freq	5 kHz	0.95		1.05	V
	10 kHz	0.95		1.05	V
	15 kHz	0.95		1.05	V
	20 kHz	0.95		1.05	V
DFD d2 Inherent Distortion					
Diff Freq	425 Hz				
Mean Freq	5 kHz			–114	dB
	20 kHz			–114	dB
DFD d3 Inherent Distortion					
Diff Freq	425 Hz				
Mean Freq	5 kHz			–92	dB
	20 kHz			–92	dB
Output Impedance					
Output	BAL				
Channel(s)	OFF				
measurement ch. 1	R_{off}				
Impedance	10 Ω	8.0		10.0	Ω
	200 Ω	199		201	Ω
	600 Ω	597		603	Ω
measurement ch. 2	R_{off}				
Impedance	10 Ω	8.0		10.0	Ω
	200 Ω	199		201	Ω
	600 Ω	597		603	Ω
Output	UNBAL				
Channel(s)	OFF				
measurement ch. 1	R_{off}	4.5		5.5	Ω
measurement ch. 2	R_{off}	4.5		5.5	Ω

- continued -

measurement		min	act.	max	unit
Output	BAL				
Impedance	10 Ω				
Channel(s)	1				
measurement ch. 1	R_{on}	8.0		10.0	Ω
Channel(s)	2				
measurement ch. 2	R_{on}	8.0		10.0	Ω
Output	UNBAL				
Channel(s)	1				
measurement ch. 1	R_{on}	4.5		5.5	Ω
Channel(s)	2				
measurement ch. 2	R_{on}	4.5		5.5	Ω
Crosstalk					
Output	UNBAL				
crosstalk	*channel 1 → 2*			–115	dB
crosstalk	*channel 2 → 1*			–115	dB
Output	BAL				
Impedance	10 Ω				
crosstalk	*channel 1 → 2*			–115	dB
crosstalk	*channel 2 → 1*			–115	dB
Output Balance					
Channel(s)	1				
Frequency	1 kHz	75			dB
Frequency	20 kHz	60			dB
Channel(s)	2				
Frequency	1 kHz	75			dB
Frequency	20 kHz	60			dB

2.3.2 Performance Test Report of Analog Analyzer

Audio Analyzer UPL **Rohde & Schwarz**

UPL / Analog Analyzer

Order No. 1078.2008 **Date: . . . .**

Serial No.: . . . . **Name: . . . .**

measurement		min	act.	max	unit
Level Measurement RMS					
Level Accuracy at 1kHz					
Analyzer	ANLG 22kHz				
Channel(s)	2 ≡ 1				
Input	BAL				
Impedance	200 kΩ				
Function	RMS				
measurement on ch. 1					
Range FIX	input voltage	−Tol.		+Tol.	
100 mV	75 mV	−0.05		0.05	dB
300 mV	225 mV	−0.05		0.05	dB
3 V	2.25 V	−0.05		0.05	dB
6 V	4,5 V	−0.05		0.05	dB
10 V	7,5 V	−0.05		0.05	dB
30 V	22.5 V	−0.05		0.05	dB
measurement on ch. 2					
Range FIX	input voltage	−Tol.		+Tol.	
100 mV	75 mV	−0.05		0.05	dB
300 mV	225 mV	−0.05		0.05	dB
3 V	2.25 V	−0.05		0.05	dB
6 V	4,5 V	−0.05		0.05	dB
10 V	7,5 V	−0.05		0.05	dB
30 V	22.5 V	−0.05		0.05	dB
Analyzer	ANLG 110kHz				
Channel(s)	2 ≡ 1				
Input	BAL				
Impedance	200 kΩ				
Function	RMS				
measurement on ch. 1					
Range FIX	input voltage	−Tol.		+Tol.	
3 V	2.25 V	−0.05		0.05	dB
measurement on ch. 2					

- continued -

measurement		min	act.	max	unit
Range FIX 3 V	input voltage 2.25 V	−Tol. −0.05		+Tol. 0.05	dB
linearity at 20 kHz					
Analyzer Channel(s) Input Impedance Range Function	ANLG 22kHz 1 ≡ 2 BAL 200 kΩ FIX 1V RMS				
measurement on ch. 1					
input signal	Voltage	−Tol.		+Tol.	
20 kHz	0.1 V	−0.25		0.25	%
	0.2 V	−0.25		0.25	%
	0.3 V	−0.1		0.1	%
	0.4 V	−0.1		0.1	%
	0.5 V	−0.1		0.1	%
	0.7 V	−0.1		0.1	%
	1 V	−0.1		0.1	%
	1.15 V	−0.1		0.1	%
measurement on ch. 2					
input signal	Voltage	−Tol.		+Tol.	
20 kHz	0.1 V	−0.25		0.25	%
	0.2 V	−0.25		0.25	%
	0.3 V	−0.1		0.1	%
	0.4 V	−0.1		0.1	%
	0.5 V	−0.1		0.1	%
	0.7 V	−0.1		0.1	%
	1 V	−0.1		0.1	%
	1.15 V	−0.1		0.1	%
Analyzer Channel(s) Input Impedance Range Function	ANLG 110kHz 1 ≡ 2 BAL 200 kΩ FIX 1V RMS				
measurement on ch. 1					
input signal	Voltage	−Tol.		+Tol.	
20 kHz	0.1 V	−0.3		0.3	%
	0.2 V	−0.25		0.25	%
	0.3 V	−0.1		0.1	%
	0.4 V	−0.1		0.1	%
	0.5 V	−0.1		0.1	%
	0.7 V	−0.1		0.1	%
	1 V	−0.1		0.1	%
	1.15 V	−0.1		0.1	%

- continued -

measurement		min	act.	max	unit
frequency response					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Function	RMS				
measurement on ch. 1					
Range	FIX 3V				
input signal	Freq	−Tol.		+Tol.	
2.25 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
Range	FIX 6V				
input signal	Freq	−Tol.		+Tol.	
4.5 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
Range	FIX 30V				
input signal	Freq	−Tol.		+Tol.	
22.5 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB

- continued -

measurement		min	act.	max	unit
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
measurement on ch. 2					
Range	FIX 3V				
input signal	Freq	−Tol.		+Tol.	
2.25 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
Range	FIX 6V				
input signal	Freq	−Tol.		+Tol.	
4.5 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
Range	FIX 30V				
input signal	Freq	−Tol.		+Tol.	
22.5 V	10 Hz	−0.10		0.10	dB
	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	20 kHz	−0.03		0.03	dB
	21.75 kHz	−0.03		0.03	dB
Analyzer	ANLG 110kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				

- continued -

measurement		min	act.	max	unit
Function	RMS				
measurement on ch. 1					
Range	FIX 100 mV				
input signal	Freq	–Tol.		+Tol.	
75 mV	20 Hz	–0.03		0.03	dB
	100 Hz	–0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	–0.03		0.03	dB
	5 kHz	–0.03		0.03	dB
	10 kHz	–0.03		0.03	dB
	15 kHz	–0.03		0.03	dB
	22 kHz	–0.03		0.03	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.2		0.2	dB
Range	FIX 300 mV				
input signal	Freq	–Tol.		+Tol.	
225 mV	20 Hz	–0.03		0.03	dB
	100 Hz	–0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	–0.03		0.03	dB
	5 kHz	–0.03		0.03	dB
	10 kHz	–0.03		0.03	dB
	15 kHz	–0.03		0.03	dB
	22 kHz	–0.03		0.03	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.2		0.2	dB
Range	FIX 1V				
input signal	Freq	–Tol.		+Tol.	
0.75 V	20 Hz	–0.03		0.03	dB
	100 Hz	–0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	–0.03		0.03	dB
	5 kHz	–0.03		0.03	dB
	10 kHz	–0.03		0.03	dB
	15 kHz	–0.03		0.03	dB
	22 kHz	–0.03		0.03	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.2		0.2	dB
Range	FIX 3V				
input signal	Freq	–Tol.		+Tol.	
2.25 V	20 Hz	–0.03		0.03	dB
	100 Hz	–0.03		0.03	dB

- continued -

measurement		min	act.	max	unit
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 6V				
input signal	Freq	−Tol.		+Tol.	
4.5 V	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 30V				
input signal	Freq	−Tol.		+Tol.	
22.5 V	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
measurement on ch. 2					
Range	FIX 100 mV				
input signal	Freq	−Tol.		+Tol.	
75 mV	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB

- continued -

measurement		min	act.	max	unit
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 300 mV				
input signal	Freq	−Tol.		+Tol.	
225 mV	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 1V				
input signal	Freq	−Tol.		+Tol.	
0.75 V	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 3V				
input signal	Freq	−Tol.		+Tol.	
2.25 V	20 Hz	−0.03		0.03	dB
	100 Hz	−0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	−0.03		0.03	dB
	5 kHz	−0.03		0.03	dB
	10 kHz	−0.03		0.03	dB
	15 kHz	−0.03		0.03	dB
	22 kHz	−0.03		0.03	dB
	50 kHz	−0.1		0.1	dB
	110 kHz	−0.2		0.2	dB
Range	FIX 6V				
input signal	Freq	−Tol.		+Tol.	
4.5 V	20 Hz	−0.03		0.03	dB

- continued -

measurement		min	act.	max	unit
	100 Hz	–0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	–0.03		0.03	dB
	5 kHz	–0.03		0.03	dB
	10 kHz	–0.03		0.03	dB
	15 kHz	–0.03		0.03	dB
	22 kHz	–0.03		0.03	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.2		0.2	dB
Range	FIX 30V				
input signal	Freq	–Tol.		+Tol.	
22.5 V	20 Hz	–0.03		0.03	dB
	100 Hz	–0.03		0.03	dB
	1 kHz	0		0	dB
	2 kHz	–0.03		0.03	dB
	5 kHz	–0.03		0.03	dB
	10 kHz	–0.03		0.03	dB
	15 kHz	–0.03		0.03	dB
	22 kHz	–0.03		0.03	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.2		0.2	dB
Inherent Noise					
Analyzer	ANLG 22kHz				
Min Freq	10 Hz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	300Ω				
Range	FIX 18 mV				
	oder AUTO				
Function	RMS				
Filter	CCIR UNWTD				
measurement on ch. 1				2	μV
measurement on ch. 2				2	μV
Function	QPEAK				
Meas Time	SLOW				
Filter	CCIR WTD				
measurement on ch. 1				8	μV
measurement on ch. 2				8	μV
Analyzer	ANLG 110kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	300 Ω				

- continued -

measurement		min	act.	max	unit
Function	RMS				
Filter	OFF				
measurement on ch. 1				8	μV
measurement on ch. 2				8	μV
input resistance					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Range	FIX 30 V				
measurement on ch. 1					
Impedance	200 kΩ	199.0		201.0	kΩ
	600 Ω	597		603	Ω
	300 Ω	298.5		301.5	Ω
measurement on ch. 2					
Impedance	200 kΩ	199.0		201.0	kΩ
	600 Ω	597		603	Ω
	300 Ω	298.5		301.5	Ω
crosstalk attenuation					
Analyzer	ANLG 22kHz				
Channel(s)	1 & 2				
Input	BAL				
Impedance	200 kΩ				
Range	AUTO				
Function	RMS SELECT				
input signal	10 V, 20kHz				
Impedance Ch2	600Ω				
crosstalk	channel 1 → 2			−120	dB
Impedance Ch1	600Ω				
crosstalk	channel 2 → 1			−120	dB
common-mode rejection					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Function	RMS SELECT				
measurement on ch. 1					
Range	18.0 mV				
input signal	50 Hz, 3 V			−100	dB

- continued -

measurement		min	act.	max	unit
	1 kHz			–86	dB
	16 kHz			–80	dB
Range	3.0 V				
input signal	50 Hz, 3 V			–100	dB
	1 kHz			–86	dB
	16 kHz			–80	dB
Range	10.0 V				
input signal	50 Hz, 10 V			–60	dB
	1 kHz			–60	dB
	16 kHz			–60	dB
Range	30.0 V				
input signal	50 Hz, 10 V			–50	dB
	1 kHz			–50	dB
	16 kHz			–50	dB
measurement on ch. 2					
Range	18.0 mV				
input signal	50 Hz, 3 V			–100	dB
	1 kHz			–86	dB
	16 kHz			–80	dB
Range	3.0 V				
input signal	50 Hz, 3 V			–100	dB
	1 kHz			–86	dB
	16 kHz			–80	dB
Range	10.0 V				
input signal	50 Hz, 10 V			–60	dB
	1 kHz			–60	dB
	16 kHz			–60	dB
Range	30.0 V				
input signal	50 Hz, 10 V			–50	dB
	1 kHz			–50	dB
	16 kHz			–50	dB
frequency measurement					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 1V				
Freq/Phase	FREQ				
Meas Time	250 ms				
measurement on ch. 1					
input signal	Freq	–Tol.		+Tol.	
1 V	20 Hz	–50		50	ppm
	1 kHz	–50		50	ppm

- continued -

measurement		min	act.	max	unit
	110 kHz	–50		50	ppm
0.1 V	10 Hz	–50		50	ppm
	100 Hz	–50		50	ppm
	1 kHz	–50		50	ppm
	110 kHz	–50		50	ppm
measurement on ch. 2					
input signal	Freq	–Tol.		+Tol.	
1 V	20 Hz	–50		50	ppm
	1 kHz	–50		50	ppm
	110 kHz	–50		50	ppm
0.1 V	20 Hz	–50		50	ppm
	100 Hz	–50		50	ppm
	1 kHz	–50		50	ppm
	110 kHz	–50		50	ppm
Analyzer	ANLG 110kHz				
Channel(s)	1 ≡ 2				
measurement on ch. 1					
input signal	Freq	–Tol.		+Tol.	
1 V	20 Hz	–50		50	ppm
	1 kHz	–50		50	ppm
	110 kHz	–50		50	ppm
0.1 V	20 Hz	–50		50	ppm
	1 kHz	–50		50	ppm
	110 kHz	–50		50	ppm
phase measurement					
phase coherence of both channels					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Freq/Phase	PHASE				
Range FIX	18 mV				
input signal	Freq				
13.5 mV	20 Hz	–0.4		0.4	°
	100 Hz	–0.4		0.4	°
	1 kHz	–0.4		0.4	°
	10 kHz	–0.4		0.4	°
	21.75 kHz	–0.4		0.4	°
Range FIX	3 V				
input signal	Freq				
2.25 V	20 Hz	–0.4		0.4	°
	100 Hz	–0.4		0.4	°
	1 kHz	–0.4		0.4	°

- continued -

measurement		min	act.	max	unit
	10 kHz	−0.4		0.4	°
	21.75 kHz	−0.4		0.4	°
Range FIX	10 V				
input signal	Freq				
7.5 V	100 Hz	−0.4		0.4	°
	1 kHz	−0.4		0.4	°
	10 kHz	−0.4		0.4	°
	21.75 kHz	−0.4		0.4	°
Range FIX	30 V				
input signal	Freq				
22.5 V	100 Hz	−0.4		0.4	°
	1 kHz	−0.4		0.4	°
	10 kHz	−0.4		0.4	°
	21.75 kHz	−0.4		0.4	°
DC measurement					
offset voltage					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Function	DC				
measurement on ch. 1					
Range FIX	input voltage				
100 mV	0 V	−2		2	mV
300 mV		−2		2	mV
1.0 V		−2		2	mV
3.0 V		−2		2	mV
10.0 V		−10		10	mV
30.0 V		−10		10	mV
measurement on ch. 2					
Range FIX	input voltage				
100 mV	0 V	−2		2	mV
300 mV		−2		2	mV
1.0 V		−2		2	mV
3.0 V		−2		2	mV
10.0 V		−10		10	mV
30.0 V		−10		10	mV
Analyzer	ANLG 110kHz				
measurement on ch. 1					
Range FIX	input voltage				
3.0 V	0 V	−2		2	mV
DC measurement accuracy					
Analyzer	ANLG 22kHz				

- continued -

measurement		min	act.	max	unit
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
Function	DC				
measurement on ch. 1		−Tol.		+Tol.	
input voltage	+4.5 V	−0.2		0.2	%
	−4.5 V	−0.2		0.2	%
	+2.5 V	−0.2		0.2	%
	−2.5 V	−0.2		0.2	%
	+1.5 V	−0.2		0.2	%
	−1.5 V	−0.2		0.2	%
	+0.5 V	−0.2		0.2	%
	−0.5 V	−0.2		0.2	%
	+0.3 V	−0.2		0.2	%
	−0.3 V	−0.2		0.2	%
measurement on ch. 2		−Tol.		+Tol.	
input voltage	+4.5 V	−0.2		0.2	%
	−4.5 V	−0.2		0.2	%
	+2.5 V	−0.2		0.2	%
	−2.5 V	−0.2		0.2	%
	+1.5 V	−0.2		0.2	%
	−1.5 V	−0.2		0.2	%
	+0.5 V	−0.2		0.2	%
	−0.5 V	−0.2		0.2	%
	+0.3 V	−0.2		0.2	%
	−0.3 V	−0.2		0.2	%
Analyzer	ANLG 110kHz				
measurement on ch. 1		−Tol.		+Tol.	
input voltage	+4.5 V	−0.2		0.2	%
	−4.5 V	−0.2		0.2	%
	+3,0 V	−0,2		0,2	%
	−3,0 V	−0,2		0,2	%
	+2.5 V	−0.2		0.2	%
	−2.5 V	−0.2		0.2	%
	+2.0 V	−0.2		0.2	%
	−2.0 V	−0.2		0.2	%
	+1.5 V	−0.2		0.2	%
	−1.5 V	−0.2		0.2	%
	+1.0 V	−0.2		0.2	%
	−1.0 V	−0.2		0.2	%
	+0.5 V	−0.2		0.2	%
	−0.5 V	−0.2		0.2	%
	+0.3 V	−0.3		0.3	%
	−0.3 V	−0.3		0.3	%

- continued -

measurement		min	act.	max	unit
Total Harmonic Distortion					
THD measurement accuracy ≥ –60dB					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
Function	THD				
Meas Mode	d2				
measurement on ch. 1					
input signal	9 kHz, 2 V				
harmonic d2	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
	–30 dB	–30.5		–29.5	dB
	–20 dB	–20.5		–19.5	dB
measurement on ch. 2					
input signal	9 kHz, 2 V				
harmonic d2	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
	–30 dB	–30.5		–29.5	dB
	–20 dB	–20.5		–19.5	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
input signal	22 kHz, 2 V				
harmonic d2	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
	–30 dB	–30.5		–29.5	dB
	–20 dB	–20.5		–19.5	dB
THD measurement accuracy < –60dB					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
Function	THD				
Meas Mode	d2				
measurement on ch. 1					
input signal	9 kHz, 2 V				
harmonic d2	–70 dB	–70.5		–69.5	dB
	–65 dB	–65.5		–64.5	dB
	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
measurement on ch. 2					

- continued -

measurement		min	act.	max	unit
input signal	9 kHz, 2 V				
harmonic d2	–70 dB	–70.5		–69.5	dB
	–65 dB	–65.5		–64.5	dB
	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
input signal	21kHz, 2 V				
harmonic d2	–70 dB	–70.5		–69.5	dB
	–65 dB	–65.5		–64.5	dB
	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
measurement on ch. 2					
input signal	21kHz, 2 V				
harmonic d2	–70 dB	–70.5		–69.5	dB
	–65 dB	–65.5		–64.5	dB
	–60 dB	–60.5		–59.5	dB
	–50 dB	–50.5		–49.5	dB
Notchfilter frequency response					
Analyzer	ANLG 110kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
Function	THD				
Meas Mode	d2				
measurement on ch. 1					
input signal	harmonic d2				
100 Hz, 2 V	–60 dB	–60.5		–59.5	dB
470 Hz, 2 V	–60 dB	–60.5		–59.5	dB
1 kHz	–60 dB	–60.5		–59.5	dB
3.2 kHz	–60 dB	–60.5		–59.5	dB
10 kHz	–60 dB	–60.5		–59.5	dB
15 kHz	–60 dB	–60.5		–59.5	dB
22 kHz	–60 dB	–60.5		–59.5	dB
measurement on ch. 2					
input signal	harmonic d2				
100 Hz, 2 V	–60 dB	–60.5		–59.5	dB
470 Hz, 2 V	–60 dB	–60.5		–59.5	dB
1 kHz	–60 dB	–60.5		–59.5	dB
3.2 kHz	–60 dB	–60.5		–59.5	dB
10 kHz	–60 dB	–60.5		–59.5	dB
15 kHz	–60 dB	–60.5		–59.5	dB
22 kHz	–60 dB	–60.5		–59.5	dB
THD intrinsic distortion					

- continued -

measurement		min	act.	max	unit
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Function	THD				
Meas Mode	all di				
measurement on ch. 1					
input signal BAL	Range FIX				
10 V, 10 Hz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 10 Hz	3 V			−100	
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 20 Hz	10.0 V			−110	
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 20 Hz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 50 Hz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 50 Hz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 100 Hz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 100 Hz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 450 Hz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 450 Hz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			−110	dB
2 V	3 V			−110	dB

- continued -

measurement		min	act.	max	unit
input signal UNBAL	Range FIX				
2 V, 1.0 kHz	3 V			–110	dB
1 V	1 V			–110	dB
input signal BAL	Range FIX				
10 V, 3.0 kHz	10.0 V			–110	dB
2 V	3 V			–110	dB
input signal UNBAL	Range FIX				
2 V, 3.0 kHz	3 V			–110	dB
1 V	1 V			–110	dB
input signal BAL	Range FIX				
10 V, 7.0 kHz	10.0 V			–110	dB
2 V	3 V			–110	dB
input signal UNBAL	Range FIX				
2 V, 7.0 kHz	3 V			–110	dB
1 V	1 V			–110	dB
measurement on ch. 2					
input signal BAL	Range FIX				
10 V, 10 Hz	10.0 V			–100	dB
2 V	3 V			–100	dB
input signal UNBAL	Range FIX				
2 V, 10 Hz	3 V			–100	dB
1 V	1 V			–100	dB
input signal BAL	Range FIX				
10 V, 20 Hz	10.0 V			–110	dB
2 V	3 V			–110	dB
input signal UNBAL	Range FIX				
2 V, 20 Hz	3 V			–110	dB
1 V	1 V			–110	dB
input signal BAL	Range FIX				
10 V, 50 Hz	10.0 V			–110	dB
2 V	3 V			–110	dB
input signal UNBAL	Range FIX				
2 V, 50 Hz	3 V			–110	dB
1 V	1 V			–110	dB
input signal BAL	Range FIX				
10 V, 100 Hz	10.0 V			–110	dB
2 V	3 V			–110	dB
input signal UNBAL	Range FIX				
2 V, 100 Hz	3 V			–110	dB
1 V	1 V			–110	dB

- continued -

measurement		min	act.	max	unit
input signal BAL	Range FIX				
10 V, 450 Hz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 450 Hz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 1.0 kHz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 3.0 kHz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 3.0 kHz	3 V			−110	dB
1 V	1 V			−110	dB
input signal BAL	Range FIX				
10 V, 7.0 kHz	10.0 V			−110	dB
2 V	3 V			−110	dB
input signal UNBAL	Range FIX				
2 V, 7.0 kHz	3 V			−110	dB
1 V	1 V			−110	dB
Analyzer	ANLG 110kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Function	THD				
Meas Mode	all di				
measurement on ch. 1					
input signal BAL	Range FIX				
10 V, 50 Hz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 50 Hz	3 V			−100	
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 100 Hz	10.0 V			−100	dB
2 V	3 V			−100	dB

- continued -

measurement		min	act.	max	unit
input signal UNBAL	Range FIX				
2 V, 100 Hz	3 V			−100	dB
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 450 Hz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 450 Hz	3 V			−100	dB
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 1.0 kHz	3 V			−100	dB
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 3.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 3.0 kHz	3 V			−100	dB
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 7.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 7.0 kHz	3 V			−100	dB
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 22.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 22.0 kHz	3 V			−100	dB
1 V	1 V			−100	dB
measurement on ch. 2					
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 1.0 kHz	3 V			−100	dB

- continued -

measurement		min	act.	max	unit
1 V	1 V			−100	dB
input signal BAL	Range FIX				
10 V, 22.0 kHz	10.0 V			−100	dB
2 V	3 V			−100	dB
input signal UNBAL	Range FIX				
2 V, 22.0 kHz	3 V			−100	dB
1 V	1 V			−100	dB
THD Inherent Distortion, loop measurement, Generator-Analyzer					
Output	UNBAL				
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	1 kHz			−107	dB
Voltage	2.5000V				
Frequency	20 Hz			−110	dB
	1 kHz			−110	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	20 kHz			−97	dB
Voltage	2.5000V				
Frequency	7 kHz			−100	dB
	20 kHz			−100	dB
Output	BAL				
Impedance	10Ω				
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	1 kHz			−107	dB
Voltage	2.5000V				
Frequency	20 Hz			−110	dB
	1 kHz			−110	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	20 kHz			−97	dB
Voltage	2.5000V				
Frequency	7 kHz			−100	dB
	20 kHz			−100	dB
distortion factor THD+N					
THD+N intrinsic distortion					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				

- continued -

measurement		min	act.	max	unit
Input	BAL				
Impedance	200 kΩ				
Function	THD+N				
FrqLim low	20 Hz				
FrqLim upp	21.938 kHz				
measurement on ch. 1					
input signal BAL	Range FIX				
10 V, 20 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 50 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 100 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 450 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 1.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 3.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 7.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 20.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB

- continued -

measurement		min	act.	max	unit
1 V	1.0 V			−104	dB
measurement on ch. 2					
input signal BAL	Range FIX				
10 V, 20 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 50 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 100 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 450 Hz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 1.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 3.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 7.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
10 V, 20.0 kHz	10.0 V			−104	dB
3 V	6.0 V			−99	dB
2 V	3.0 V			−101	dB
1 V	1.0 V			−104	dB
Analyzer	ANLG 110kHz				
FrqLim low	200 Hz				

- continued -

measurement		min	act.	max	unit
FrqLim upp	20 kHz				
measurement on ch. 1					
input signal BAL	Range FIX				
10 V, 500 Hz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
10 V, 1.0 kHz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
10 V, 7.0 kHz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
10 V, 22.0 kHz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
measurement on ch. 2					
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
10 V, 22.0 kHz	10.0 V			–97	dB
3 V	6.0 V			–91	dB
2 V	3.0 V			–94	dB
1 V	1.0 V			–97	dB
Analyzer	ANLG 110kHz				
FrqLim low	200 Hz				
FrqLim upp	110 kHz				
measurement on ch. 1					
input signal BAL	Range FIX				
10 V, 500 Hz	10.0 V			–90	dB
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
10 V, 1.0 kHz	10.0 V			–90	dB

- continued -

measurement		min	act.	max	unit
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
10 V, 7.0 kHz	10.0 V			–90	dB
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
10 V, 22.0 kHz	10.0 V			–90	dB
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
measurement on ch. 2					
input signal BAL	Range FIX				
10 V, 1.0 kHz	10.0 V			–90	dB
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
10 V, 22.0 kHz	10.0 V			–90	dB
3 V	6.0 V			–84	dB
2 V	3.0 V			–87	dB
1 V	1.0 V			–90	dB
THD+N Inherent Distortion, loop measurement, Generator-Analyzer					
Output	UNBAL				
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	20 Hz			–100	dB
	1 kHz			–100	dB
	10 kHz			–100	dB
	20 kHz			–100	dB
Voltage	3.0000V				
Frequency	1 kHz			–105	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	1 kHz			–88	dB
	20 kHz			–88	dB
Voltage	3.0000V				
Frequency	1 kHz			–88	dB
Output	BAL				
Impedance	10Ω				

- continued -

measurement		min	act.	max	unit
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	20 Hz			–100	dB
	1 kHz			–100	dB
	10 kHz			–100	dB
	20 kHz			–100	dB
Voltage	3.0000V				
Frequency	1 kHz			–105	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	1 kHz			–88	dB
	20 kHz			–88	dB
Voltage	3.0000V				
Frequency	1 kHz			–88	dB

Intermodulation MOD DIST

MOD DIST measurement accuracy		min	act.	max	unit
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3.0 V				
measurement on ch. 1					
input signal	distortion				
$U_{RF} = 0.7V$					
f_{RF} f_{AF}	rated value				
4kHz 500Hz					
U_3, U_4, U_5, U_6 /dBr					
20, 20, 20, –140	–40 dB	–40.5		–39.5	dB
0, 0, 0, –140	–60 dB	–60.5		–59.5	dB
–10, –10, –10, –140	–70 dB	–70.5		–69.5	dB
–20, –20, –20, –140	–80 dB	–81		–79	dB
–20, –20, –20, –20	–80 dB	–81		–79	dB
7kHz 60Hz					
U_3, U_4, U_5, U_6 /dBr					
–14, –20, –20, –140	–71 dB	–71.5		–70.5	dB
15kHz 200Hz					
U_3, U_4, U_5, U_6 /dBr					
–20, –20, –20, –20	–71 dB	–71.5		–70.5	dB
20kHz 500Hz					
U_3, U_4, U_5, U_6 /dBr					
–140,–140,–140,–10	–70 dB	–70.5		–69.5	dB
measurement on ch. 2					
input signal	distortion				

- continued -

measurement			min	act.	max	unit
$U_{RF} = 0.7V$						
f_{RF}	f_{AF}	rated value				
4kHz	500Hz					
U_3, U_4, U_5, U_6 /dBr						
20, 20, 20, −140		−40 dB	−40.5		−39.5	dB
0, 0, 0, −140		−60 dB	−60.5		−59.5	dB
−10, −10, −10, −140		−70 dB	−70.5		−69.5	dB
−20, −20, −20, −140		−80 dB	−81		−79	dB
−20, −20, −20, −20		−80 dB	−81		−79	dB
7kHz	60Hz					
U_3, U_4, U_5, U_6 /dBr						
−14, −20, −20, −140		−71 dB	−71.5		−70.5	dB
15kHz	200Hz					
U_3, U_4, U_5, U_6 /dBr						
−20, −20, −20, −20		−71 dB	−71.5		−70.5	dB
20kHz	500Hz					
U_3, U_4, U_5, U_6 /dBr						
−140,−140,−140,−10		−70 dB	−70.5		−69.5	dB
MOD DIST intrinsic distortion						
Analyzer	ANLG 22kHz					
Channel(s)	$1 \equiv 2$					
Input	BAL					
Impedance	200 kΩ					
measurement on ch. 1						
Range	FIX 6V					
input signal	$V_{rms} = 5V$					
f_{RF}	f_{AF}					
4kHz	30Hz				−90	dB
	200Hz				−96	dB
	500Hz				−96	dB
7kHz	30Hz				−90	dB
	200Hz				−96	dB
	500Hz				−96	dB
15kHz	30Hz				−85	dB
	200Hz				−96	dB
	500Hz				−96	dB
20kHz	60Hz				−85	dB
	200Hz				−96	dB
	500Hz				−96	dB
Range	FIX 3V					
input signal	$V_{rms} = 3V$					
f_{RF}	f_{AF}					
4kHz	30Hz				−90	dB
	200Hz				−96	dB

- continued -

measurement		min	act.	max	unit
	500Hz			−96	dB
7kHz	30Hz			−90	dB
	200Hz			−96	dB
	500Hz			−96	dB
15kHz	30Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
20kHz	60Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
measurement on ch. 2					
Range	FIX 6V				
input signal	$V_{rms} = 5V$				
f_{RF}	f_{AF}				
4kHz	30Hz			−90	dB
	200Hz			−96	dB
	500Hz			−96	dB
7kHz	30Hz			−90	dB
	200Hz			−96	dB
	500Hz			−96	dB
15kHz	30Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
20kHz	60Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
Range	FIX 3V				
input signal	$V_{rms} = 3V$				
f_{RF}	f_{AF}				
4kHz	30Hz			−90	dB
	200Hz			−96	dB
	500Hz			−96	dB
7kHz	30Hz			−90	dB
	200Hz			−96	dB
	500Hz			−96	dB
15kHz	30Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
20kHz	60Hz			−85	dB
	200Hz			−96	dB
	500Hz			−96	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
Range	FIX 6V				

- continued -

measurement		min	act.	max	unit
input signal	$V_{rms} = 5V$				
f_{RF}	f_{AF}				
4kHz	200Hz			–80	dB
	500Hz			–80	dB
7kHz	200Hz			–80	dB
	500Hz			–80	dB
20kHz	200Hz			–80	dB
	500Hz			–80	dB
50kHz	200Hz			–80	dB
	500Hz			–80	dB
100kHz	200Hz			–80	dB
	500Hz			–80	dB
Range	FIX 3V				
input signal	$V_{rms} = 3V$				
f_{RF}	f_{AF}				dB
4kHz	200Hz			–80	dB
	500Hz			–80	dB
7kHz	200Hz			–80	dB
	500Hz			–80	dB
20kHz	200Hz			–80	dB
	500Hz			–80	dB
50kHz	200Hz			–80	dB
	500Hz			–80	dB
100kHz	200Hz			–80	dB
	500Hz			–80	dB
measurement on ch. 2					
Range	FIX 6V				
input signal	$V_{rms} = 5V$				
f_{RF}	f_{AF}				
4kHz	200Hz			–80	dB
	500Hz			–80	dB
7kHz	200Hz			–80	dB
	500Hz			–80	dB
20kHz	200Hz			–80	dB
	500Hz			–80	dB
50kHz	200Hz			–80	dB
	500Hz			–80	dB
100kHz	200Hz			–80	dB
	500Hz			–80	dB
Range	FIX 3V				
input signal	$V_{rms} = 3V$				
f_{RF}	f_{AF}				dB
4kHz	200Hz			–80	dB

- continued -

measurement		min	act.	max	unit
	500Hz			–80	dB
7kHz	200Hz			–80	dB
	500Hz			–80	dB
20kHz	200Hz			–80	dB
	500Hz			–80	dB
50kHz	200Hz			–80	dB
	500Hz			–80	dB
100kHz	200Hz			–80	dB
	500Hz			–80	dB
differential tone factor DFD					
DFD-d2 measurement accuracy					
Analyzer	ANLG 22kHz				
Channel(s)	$1 \equiv 2$				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
measurement on ch. 1					
input signal	DFD d2				
$U_1 = U_2 =$ 1V (–6 dBr)	rated value				
f_{Mean} f_{Diff}					
7 kHz 400 Hz					
$U_3 =$ –20 dB	–20 dB	–20.5		–19.5	dB
$U_3 =$ –50 dB	–50 dB	–50.5		–49.5	dB
$U_3 =$ –60 dB	–60 dB	–60.5		–59.5	dB
measurement on ch. 2					
input signal	DFD d2				
$U_1 = U_2 =$ 1V (–6 dBr)	rated value				
f_{Mean} f_{Diff}					
7 kHz 400 Hz					
$U_3 =$ –20 dB	–20 dB	–20.5		–19.5	dB
$U_3 =$ –50 dB	–50 dB	–50.5		–49.5	dB
$U_3 =$ –60 dB	–60 dB	–60.5		–59.5	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
input signal	DFD d2				
$U_1 = U_2 =$ 1V (–6 dBr)	rated value				
f_{Mean} f_{Diff}					
5 kHz 200Hz					
$U_3 =$ –40 dB	–40 dB	–40.5		–39.5	dB
20 kHz 300 Hz					
$U_3 =$ –60 dB	–60 dB	–60.5		–59.5	dB
50 kHz 500 Hz					
$U_3 =$ –50 dB	–50 dB	–50.5		–49.5	dB

- continued -

measurement		min	act.	max	unit
100 kHz 1000 Hz					
$U_3 = -60$ dB	−60 dB	−60.5		−59.5	dB
100 kHz 2000 Hz					
$U_3 = -60$ dB	−60 dB	−60.5		−59.5	dB
measurement on ch. 2					
input signal	DFD d2				
$U_1 = U_2 = 1$V (−6 dBr)	rated value				
f_{Mean} f_{Diff}					
5 kHz 200 Hz					
$U_3 = -40$ dB	−40 dB	−40.5		−39.5	dB
20 kHz 300 Hz					
$U_3 = -60$ dB	−60 dB	−60.5		−59.5	dB
50 kHz 500 Hz					
$U_3 = -50$ dB	−50 dB	−50.5		−49.5	dB
100 kHz 1000 Hz					
$U_3 = -60$ dB	−60 dB	−60.5		−59.5	dB
100 kHz 2000 Hz					
$U_3 = -60$ dB	−60 dB	−60.5		−59.5	dB
DFD-d3 measurement accuracy					
Analyzer	ANLG 22kHz				
Channel(s)	1 ≡ 2				
Input	BAL				
Impedance	200 kΩ				
Range	FIX 3V				
measurement on ch. 1					
input signal	DFD d3				
$U_1 = U_2 = 1$V (−6 dBr)	rated value				
$U_3 = -140$dBr					
f_{Mean} f_{Diff}					
15 kHz 100 Hz					
U_4 −60 dB, U_5 −60 dB	−54 dB	−54.5		−53.5	dB
15 kHz 200 Hz					
U_4 −40 dB, U_5 −140 dB	−40 dB	−40.5		−39.5	dB
15 kHz 500 Hz					
U_4 −140 dB, U_5 −60 dB	−60 dB	−60.5		−59.5	dB
7 kHz 1000 Hz					
U_4 −20 dB, U_5 −60 dB	−20 dB	−20.5		−19.5	dB
7 kHz 2000 Hz					
U_4 −60 dB, U_5 −60 dB	−54 dB	−54.5		−53.5	dB
measurement on ch. 2					
input signal	DFD d3				
$U_1 = U_2 = 1$V (−6 dBr)	rated value				
f_{Mean} f_{Diff}					
15 kHz 100 Hz					
U_4 −60 dB, U_5 −60 dB	−54 dB	−54.5		−53.5	dB

- continued -

measurement		min	act.	max	unit
15 kHz 200 Hz					
U_4 –40 dB, U_5 –140 dB	–40 dB	–40.5		–39.5	dB
15 kHz 500 Hz					
U_4 –140 dB, U_5 –60 dB	–60 dB	–60.5		–59.5	dB
7 kHz 1000 Hz					
U_4 –20 dB, U_5 –60 dB	–20 dB	–20.5		–19.5	dB
7 kHz 2000 Hz					
U_4 –60 dB, U_5 –60 dB	–54 dB	–54.5		–53.5	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
input signal	DFD d3				
$U_1 = U_2 =$ 1V (–6 dBr)	rated value				
$U_3 =$ –140dBr					
7 kHz 2000 Hz					
U_4 –60 dB, U_5 –60 dB	–54 dB	–54.75		–53.25	dB
7 kHz 1000 Hz					
U_4 –20 dB, U_5 –140 dB	–20 dB	–20.75		–19.25	dB
f_{Mean} f_{Diff}					
25 kHz 500 Hz					
U_4 –60 dB, U_5 –60 dB	–54 dB	–54.75		–53.25	dB
75 kHz 200 Hz					
U_4 –140 dB, U_5 –40 dB	–40 dB	–40.75		–39.25	dB
measurement on ch. 2					
input signal	DFD d3				
$U_1 = U_2 =$ 1V (–6 dBr)	rated value				
$U_3 =$ –140dBr					
7 kHz 2000 Hz					
U_4 –60 dB, U_5 –60 dB	–54 dB	–54.75		–53.25	dB
7 kHz 1000 Hz					
U_4 –20 dB, U_5 –140 dB	–20 dB	–20.75		–19.25	dB
f_{Mean} f_{Diff}					
25 kHz 500 Hz					
U_4 –60 dB, U_5 –60 dB	–54 dB	–54.75		–53.25	dB
75 kHz 200 Hz					
U_4 –140 dB, U_5 –40 dB	–40 dB	–40.75		–39.25	dB
DFD-d2 inherent distortion					
Analyzer	ANLG 22kHz				
Channel(s)	$1 \equiv 2$				
Input	BAL				
Impedance	200 kΩ				
measurement on ch. 1					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			–115	dB

- continued -

measurement		min	act.	max	unit
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
15kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
20kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.3V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
15kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
20kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
measurement on ch. 2					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB
	975Hz			–115	dB
	2000Hz			–115	dB
15kHz	80Hz			–115	dB
	225Hz			–115	dB
	525Hz			–115	dB

- continued -

measurement		min	act.	max	unit
	975Hz			−115	dB
	2000Hz			−115	dB
20kHz	80Hz			−115	dB
	225Hz			−115	dB
	525Hz			−115	dB
	975Hz			−115	dB
	2000Hz			−115	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.3V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			−115	dB
	225Hz			−115	dB
	525Hz			−115	dB
	975Hz			−115	dB
	2000Hz			−115	dB
15kHz	80Hz			−115	dB
	225Hz			−115	dB
	525Hz			−115	dB
	975Hz			−115	dB
	2000Hz			−115	dB
20kHz	80Hz			−115	dB
	225Hz			−115	dB
	525Hz			−115	dB
	975Hz			−115	dB
	2000Hz			−115	dB
Analyzer	ANLG 110kHz				
measurement on ch. 1					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			−110	dB
	525Hz			−110	dB
	975Hz			−110	dB
	2000Hz			−110	dB
15kHz	225Hz			−110	dB
	525Hz			−110	dB
	975Hz			−110	dB
	2000Hz			−110	dB
20kHz	225Hz			−110	dB
	525Hz			−110	dB
	975Hz			−110	dB
	2000Hz			−110	dB
50kHz	225Hz			−95	dB
	525Hz			−95	dB

- continued -

measurement		min	act.	max	unit
	975Hz			–95	dB
	2000Hz			–95	dB
100kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.3V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
15kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
20kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
50kHz	225Hz			–95	dB
	525Hz			–95	dB
	975Hz			–95	dB
	2000Hz			–95	dB
100kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
measurement on ch. 2					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
15kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
20kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB

- continued -

measurement		min	act.	max	unit
	2000Hz			–110	dB
50kHz	225Hz			–95	dB
	525Hz			–95	dB
	975Hz			–95	dB
	2000Hz			–95	dB
100kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.3V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
15kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
20kHz	225Hz			–110	dB
	525Hz			–110	dB
	975Hz			–110	dB
	2000Hz			–110	dB
50kHz	225Hz			–95	dB
	525Hz			–95	dB
	975Hz			–95	dB
	2000Hz			–95	dB
100kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
DFD-d3 inherent distortion					
Analyzer	ANLG 22kHz				
Channel(s)	$1 \equiv 2$				
Input	BAL				
Impedance	200 kΩ				
measurement on ch. 1					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB

- continued -

measurement		min	act.	max	unit
	975Hz			-96	dB
	2000Hz			-96	dB
15kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
20kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.0V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
15kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
20kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
measurement on ch. 1					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
15kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB

- continued -

measurement		min	act.	max	unit
	2000Hz			-96	dB
20kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.0V$				
f_{Mean}	f_{Diff}				
7kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
15kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
20kHz	80Hz			-96	dB
	225Hz			-96	dB
	525Hz			-96	dB
	975Hz			-96	dB
	2000Hz			-96	dB
Analyzer	ANLG 110kHz				
Channel(s)	$1 \equiv 2$				
Input	BAL				
Impedance	200 kΩ				
measurement on ch. 1					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			−80	dB
	525Hz			−80	dB
	975Hz			−80	dB
	2000Hz			−80	dB
20kHz	225Hz			−80	dB
	525Hz			−80	dB
	975Hz			−80	dB
	2000Hz			−80	dB
50kHz	225Hz			−75	dB
	525Hz			−75	dB
	975Hz			−75	dB

- continued -

measurement		min	act.	max	unit
	2000Hz			–75	dB
100kHz	225Hz			–70	dB
	525Hz			–70	dB
	975Hz			–70	dB
	2000Hz			–70	dB
Range	FIX 3V				
input signal	$V_{rms} = 2.0V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
20kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
50kHz	225Hz			–75	dB
	525Hz			–75	dB
	975Hz			–75	dB
	2000Hz			–75	dB
100kHz	225Hz			–70	dB
	525Hz			–70	dB
	975Hz			–70	dB
	2000Hz			–70	dB
measurement on ch. 2					
Range	FIX 6V				
input signal	$V_{rms} = 4V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
20kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
50kHz	225Hz			–75	dB
	525Hz			–75	dB
	975Hz			–75	dB
	2000Hz			–75	dB
100kHz	225Hz			–70	dB
	525Hz			–70	dB
	975Hz			–70	dB
	2000Hz			–70	dB

- continued -

measurement		min	act.	max	unit
Range	FIX 3V				
input signal	$V_{rms} = 2.0V$				
f_{Mean}	f_{Diff}				
7kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
20kHz	225Hz			–80	dB
	525Hz			–80	dB
	975Hz			–80	dB
	2000Hz			–80	dB
50kHz	225Hz			–75	dB
	525Hz			–75	dB
	975Hz			–75	dB
	2000Hz			–75	dB
100kHz	225Hz			–70	dB
	525Hz			–70	dB
	975Hz			–70	dB
	2000Hz			–70	dB

2.3.3 Performance Test Report of UPL-B1

Audio Analyzer UPL **Rohde & Schwarz**

Option UPL-B1 (Low Distortion Generator)

Order No. 1078.4400.02 **Date: . . . .**

Serial No.: . . . . **Name: . . . .**

measurement		min	act.	max	unit
Level Accuracy at 1 kHz					
Voltage	1.0000 V	0.9900		1.0100	V
Frequency Response UNBAL					
Channel(s)	1				
Output	UNBAL				
Voltage	2.000 V				
Frequency	10 Hz	–0.1		0.1	dB
	20 Hz	–0.05		0.05	dB
	50 Hz	–0.05		0.05	dB
	100 Hz	–0.05		0.05	dB
	200 Hz	–0.05		0.05	dB
	500 Hz	–0.05		0.05	dB
	1 kHz	0		0	dB
	2 kHz	–0.05		0.05	dB
	5 kHz	–0.05		0.05	dB
	10 kHz	–0.05		0.05	dB
	20 kHz	–0.05		0.05	dB
	50 kHz	–0.1		0.1	dB
	110 kHz	–0.1		0.1	dB
Voltage	0.250 V				
Frequency	1 kHz	0		0	dB
	20 kHz	–0.05		0.05	dB
	110 kHz	–0.1		0.1	dB
Voltage	0.500 V				
Frequency	1 kHz	0		0	dB
	20 kHz	–0.05		0.05	dB
	110 kHz	–0.1		0.1	dB
Voltage	1.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	–0.05		0.05	dB
	110 kHz	–0.1		0.1	dB
Voltage	4.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	–0.05		0.05	dB

- continued -

measurement		min	act.	max	unit
	110 kHz	−0.1		0.1	dB
Voltage	8.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
	110 kHz	−0.1		0.1	dB
Channel(s)	2				
Output	UNBAL				
Voltage	2.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
	110 kHz	−0.1		0.1	dB
Frequency Response BAL					
Channel(s)	1				
Output	BAL				
Impedance	10 Ω				
Voltage	2.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
	110 kHz	−0.1		0.1	dB
Voltage	0.500 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
	110 kHz	−0.1		0.1	dB
Channel(s)	2				
Output	BAL				
Impedance	10 Ω				
Voltage	2.000 V				
Frequency	1 kHz	0		0	dB
	20 kHz	−0.05		0.05	dB
	110 kHz	−0.1		0.1	dB
Frequency Accuracy					
Frequency	10 Hz	9.95		10.05	Hz
	100 Hz	99.5		100.5	Hz
	1.000 kHz	0.95		1.05	kHz
	10.000 kHz	9.95		10.05	kHz
	20.000 kHz	19.90		20.10	kHz
	50.000 kHz	49.75		50.25	kHz
	110.000 kHz	109.45		110.55	kHz
THD Inherent Distortion					
Channel(s)	1				
Output	UNBAL				
Voltage	10.000 V				
Frequency	20 Hz			−105	dB
	1 kHz			−105	dB

- continued -

measurement		min	act.	max	unit
	7 kHz			−105	dB
	20 kHz			−100	dB
Voltage	2.5000 V				
Frequency	20 Hz			−110	dB
	1 kHz			−110	dB
	7 kHz			−105	dB
	20 kHz			−100	dB
THD+N Inherent Distortion					
Channel(s)	1				
Output	UNBAL				
Analyzer Bandwidth	*22 kHz*				
Voltage	10.000V				
Frequency	20 Hz			−100	dB
	1 kHz			−100	dB
	10 kHz			−100	dB
	20 kHz			−100	dB
Voltage	2.5000V				
Frequency	1 kHz			−100	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	10.000V				
Frequency	1 kHz			−88	dB
	20 kHz			−88	dB
Voltage	2.5000V				
Frequency	1 kHz			−88	dB
Channel(s)	1				
Output	BAL				
Impedance	10Ω				
Analyzer Bandwidth	*22 kHz*				
Voltage	20.000V				
Frequency	20 Hz			−100	dB
	1 kHz			−100	dB
	10 kHz			−100	dB
	20 kHz			−100	dB
Voltage	5.0000V				
Frequency	1 kHz			−100	dB
Analyzer Bandwidth	*100 kHz*				
Voltage	20.000V				
Frequency	1 kHz			−88	dB
	20 kHz			−88	dB
Voltage	5.0000V				
Frequency	1 kHz			−88	dB

2.3.4 Performance Test Report of UPL-B2

Audio Analyzer UPL **Rohde & Schwarz**

Option UPL-B2 (Digital Audio I/O)

Order No. 1078.4100.02 **Date: . . . .**

Serial No.: . . . . **Name: . . . .**

measurement		min	act.	max	unit
Digital Generator					
Level Accuracy of UNBAL Output					
Unbal Vpp	2.0000 V	1.8000		2.2000	Vpp
into 75 Ω load	1.0000 V	0.9000		1.1000	Vpp
	0.5000 V	0.4500		0.5500	Vpp
Level Accuracy of BAL Output					
Bal Vpp	8.0000 V	14.400		17.600	Vpp
without load resistor	4.0000 V	7.2000		8.8000	Vpp
	2.0000 V	3.6000		4.4000	Vpp
Accuracy of internal Sample Frequency					
Sample Frq	48000 Hz	47997.6		48002.4	Hz
External Synchronisation					
SYNC IN FRQ	27000 Hz	—		—	o.k.
	40000 Hz	—		—	o.k.
	55000 Hz	—		—	o.k.
Digital Analyzer					
Digital Inputs					
Voltage	1.000 FS				
Frequency	991 Hz				
Input	BAL	—		—	o.k.
	UNBAL	—		—	o.k.
	Optical	—		—	o.k.
	intern	—		—	o.k.
Measurement Functions					
Generator:					
Voltage	1.000 FS				
Frequency	991 Hz				
Analyzer:					
Input	BAL, UNBAL, OPTICAL				

- continued -

measurement		min	act.	max	unit
	INTERN				
Function	THD+N	—		–126	dB
	Input Peak	–0.001		0.001	dBFS
	Frequency	990.95		991.05	Hz

2.3.5 Performance Test Report of UPL-B21

measurement		min	act.	max	unit
Professional Format					
Channel Status and User Data					
Check	Analyzer				
	Channel Status	—		—	o.k.
	User Bits	—		—	o.k.
Sample Rate Measurement					
Generator	Sample Frq				
	27000 Hz	−50		+50	ppm
	48000 Hz	−50		+50	ppm
	55000 Hz	−50		+50	ppm
Consumer Format					
Channel Status and User Data					
Check	Analyzer				
	Channel Status	—		—	o.k.
	User Bits	—		—	o.k.

2.3.6 Performance Test Report of UPL-B22

measurement		min	act.	max	unit
Common Mode					
Level Measurement UNBAL Input					
Unbal Vpp	2.0000 V	1.7000		2.3000	Vpp
	1.0000 V	0.8500		1.1500	Vpp
	0.5000 V	0.4250		0.5750	Vpp
Level Measurement BAL Input					
Bal Vpp	8.0000 V	6.8000		9.2000	Vpp
	4.0000 V	3.4000		4.6000	Vpp
	2.0000 V	1.7000		2.3000	Vpp
Common Mode Amplitude					
Analyzer Function	RMS & S/N				
Comm Freq	1 kHz				
Comm Ampl	0.0000 V	0.0000		5	mV
	0.5000 V	4.5000		5.5000	V
	7.0000 V	6.3000		7.7000	V
Common Mode Frequency Response					
Comm Ampl	1.0000 V				
Analyzer Function	RMS & S/N				
Comm Freq	10 Hz	0.9000		1.1000	V
	10 kHz	0.9000		1.1000	V
	20 kHz	0.9000		1.1000	V
(with UPL-B1)	100 kHz	0.9000		1.1000	V
Sample Rate Measurement					
Generator	Sample Frq				
	27000 Hz	-50		+50	ppm
	48000 Hz	-50		+50	ppm
	55000 Hz	-50		+50	ppm
Cable Simulator					
Generator					
UNBAL Output					
Cable Sim	OFF	15		30	ns
	LONG CABLE	60		140	ns
Generator					
BAL Output					
Cable Sim	OFF	10		25	ns
	LONG CABLE	60		140	ns
Input to REF Phase Deviation					
					- continued -

measurement		min	act.	max	unit
Phase Generation and Measurement					
Generator					
PhaseToRef	0.000 %	-3.0000		3.0000	%
	-45.00 %	-50.00		-40.00	%
	45.00 %	40.00		50.00	%
Jitter Generation and Measurement					
Jitter Amplitude					
Generator					
Sample Frq	32.000 kHz				
Jitt Freq	1.0000 kHz				
JittPkAmpl	0.1000 UI	0.090		0.110	UI
	0.5000 UI	0.450		0.550	UI
	1.0000 UI	0.900		1.100	UI
	2.5000 UI	2.250		2.750	UI
Sample Frq	44.100 kHz				
Jitt Freq	1.0000 kHz				
JittPkAmpl	0.1000 UI	0.090		0.110	UI
	0.5000 UI	0.450		0.550	UI
	1.0000 UI	0.900		1.100	UI
	2.5000 UI	2.250		2.750	UI
Sample Frq	48.000 kHz				
Jitt Freq	1.0000 kHz				
JittPkAmpl	0.1000 UI	0.090		0.110	UI
	0.5000 UI	0.450		0.550	UI
	1.0000 UI	0.900		1.100	UI
	2.5000 UI	2.250		2.750	UI
Phase Modulation	SYNC OUT				
Sample Frq	48.000 kHz				
JittPkAmpl	0.5000 UI				
Phase Deviation	Peak	2.83		3.45	rad
Jitter Frequency Response					
Generator					
Sample Frq	44.100 kHz				
JittPkAmpl	0.2500 UI				
Jitter Ref	44.1 (PLL)				
Jitt Freq	1.000 kHz	0.225		0.275	UI
	10.000 kHz	0.225		0.275	UI
	20.000 kHz	0.225		0.275	UI
with UPL-B1 only	50.000 kHz	0.175		0.325	UI
	100.00 kHz	0.125		0.325	UI
Reclocking Function					
Generator					

- continued -

measurement		min	act.	max	unit
Sample Frq	32.000 kHz				
JittPkAmpl	0.1500 UI				
Jitt Freq	1.000 kHz				
Jitter Ref	32.0 (PLL)				
REF OUT Signal		—			o.k.
Sample Frq	48.000 kHz				
JittPkAmpl	0.1500 UI				
Jitt Freq	1.000 kHz				
Jitter Ref	48.0 (PLL)				
REF OUT Signal		—			o.k.
Sample Frq	44.100 kHz				
Jitt Freq	10.000 kHz				
Jitter Ref	VARI (PLL)				
REF OUT Signal		—			o.k.

2.3.7 Performance Test Report of UPL-B5

Audio Analyzer UPL — **Rohde & Schwarz**

Option UPL-B5 (Audio Monitor)

Order No. 1078.4600.02 — **Date:** . . . .

Serial No.: . . . . — **Name:** . . . .

measurement		min	act.	max	unit
test of function					
Phone Jack		–		–	ok
Signal multiplexer		–		–	ok
Speaker		–		–	ok
capture range PLL		–		–	ok
Output Voltage Head Phone Jack					
Channel(s)	1 & 2				
Spk Volume	10%	0.035		0.048	V
	25%	0.124		0.17	V
	50%	0.475		0.645	V
	75%	1.46		1.98	V
	100%	4.25		5.25	V
Frequency Response Head Phone Jack					
Channel(s)	1 & 2				
FREQUENCY	20 Hz	−0.2		0.2	dB
	100 Hz	−0.1		0.1	dB
	1 kHz	0		0	dB
	10 kHz	−0.1		0.1	dB
	20 kHz	−0.1		0.1	dB
	50 kHz	−0.2		0.2	dB
	100 kHz	−0.2		0.2	dB
Inherent Distortion analog path THD+N					
Channel(s)	1 & 2				
Frequency	20Hz	–		−60	dB
	100Hz	–		−60	dB
	1kHz	–		−60	dB
	10kHz	–		−60	dB
	20kHz	–		−60	dB
	50kHz	–		−60	dB
	100kHz	–		−60	dB
Inherent Distortion digital pathTHD+N					
Channel(s)	1 & 2				
Frequency	20Hz	–		−60	dB

- continued -

measurement	min	act.	max	unit
100Hz	–		–60	dB
1kHz	–		–60	dB
10kHz	–		–60	dB
20kHz	–		–60	dB
50kHz	–		–60	dB
100kHz	–		–60	dB

Chapter 3
Adjustment

The general meaning of adjustment is to set the actual value of a particular parameter such that the deviation of the actual value from the nominal value does not exceed a certain tolerance (e.g. with level or frequency accuracy), or that the actual value does not exceed or fall blow a given limit value (e.g. in the case of distortion factor or common-mode rejection).

This section describes which measuring equipment is required for adjusting the UPL and the options, how the adjustment measurements are to be performed and how the correction factors are calculated and stored in the UPL.

The UPL uses two different methods of adjustment:

Hardware adjustment
By varying the value of appropriate components (e.g. potentiometers or C-trimmers) the actual value is set such that the deviation from the nominal value is within the tolerance.

Software adjustment
The deviation of the actual value from the nominal value is measured. This deviation (referred to as correction factor) is stored in the UPL and taken into account by the measurement software when controlling the analyzer and generator so that the error of the actual value remains within the tolerance.

In both cases, precise measuring instruments are required, the measurement uncertainty of which is clearly smaller than the tolerance to be achieved by means of the adjustment.

Ambient temperature: 23 ± 10 °C (73 ± 18 °F)

Warm-up time of UPL: 1 hour

3.1 Recommended Measurement Equipment

Measuring instrument	Specifications		Example
Digital Multimeter as AC Voltmeter	AC, DC measurement 2 Hz – 110 kHz 15 mV – 20 V ±0.1 % ±0.2 % Input impedance > 1 MΩ	 10 Hz – 20 kHz 20 kHz – 100 kHz	HP3458A
as DC Voltmeter	±0.05 %	100 mV – 100 V	
Frequency counter	±5 ppm, 10 Hz – 110 kHz		Philips PM6680
Audio Analyzer	Selective rms measurement 80 Hz – 20 kHz 0.1 μV sensitivity		R&S UPD

3.2 Hardware Adjustment

3.2.1 Hardware Adjustment Analog Generator

PREPARATION:

▷ Open the UPL (see section 5.2.1.2, page 5.11).

▷ All adjusting devices are to be found on the analog unit. The adjusting devices of the analog generator are covered by the low distortion generator, if installed. In this case, the low distortion generator must be removed prior to the adjustment.

▷ Removing the low distortion generator:

- Place the UPL onto its left side (viewed from the front).
- The module is fastened to the analog unit using two screws; loosen these screws using a Phillips screwdriver size 1.
- Lift the module out of the red plastic supports and place it next to the UPL. Because of the short cable connection, the module must be elevated by about 5 cm (e.g. on a data book or similar).
- Do **not** remove the cable connection to the analog unit!
- The module must not touch the chassis frame of the UPL (in order to avoid ground loops, since the generator ground and the chassis are not directly connected).

▷ All adjusting devices are now easily accessible.

▷ In order to simplify operation of the UPL in this operating position, it is recommended to connect an external monitor and an external keyboard.

▷ Switch on the UPL.

Adapting the measuring instruments to the output of the generator is described in section 2.2.1 Performance Test Analog Generator, page 2.11.

The position of the adjusting devices is shown in the diagram Bottom View of UPL (section 5.2, page 5.13).

Before starting of the adjustment, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE` → `Mode` → `DEF SETUP`.

3.2.1.1 LF Adjustment Lowpass 23 kHz

CAUTION:
After this adjustment, the correction factor for the level accuracy must be redetermined! See section 3.3.2.1, page 3.15.

NOTE:
Other adjustment procedures are not affected by this adjustment.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	*)
VOLTAGE	1.0000 V

*) set according to adjustment instruction

Measuring instrument:
AC voltmeter
Relative display in Δ%, reference according to adjustment instruction

Test setup: Connect AC voltmeter to output of UPL generator.
To this end, an adapter from XLR female to 2*banana plug is required.

Adjustment:

- ▷ Set the frequency of the UPL generator to 45 Hz.
- ▷ Measure AC, use the measured value as reference.
- ▷ Set the frequency of the UPL generator to 3 Hz.
- ▷ Use R634 to adjust to the reference, tolerance ±0.1 %.
- ▷ Set the frequency of the UPL generator to 20 Hz.
- ▷ Measure AC, use the measured value as reference.
- ▷ Set the frequency of the UPL generator to 1 kHz.
- ▷ Use C494 and C497 to adjust to the reference, tolerance ±0.05 %, use the obtained measured value as new reference.
- ▷ Set the frequency of the UPL generator to 3 Hz.
- ▷ Use R634 to adjust to the reference, tolerance ±0.05 %.

C494 and C497 are parallel-connected in order to achieve the required range of adjustment.

Check: Check frequency response with 2 V, Output Unbal, channel 1 as described in the Performance Test, section 2.2.1.2, page 2.12.

3.2.1.2 20-kHz Adjustment Lowpass 23 kHz

NOTE:
Other adjustment procedures are not affected by this adjustment.

Test setup and setting of the UPL generator as before.

Adjustment:

- ▷ Set the frequency of the UPL generator to 2 kHz.
- ▷ Measure AC, use the measured value as reference.
- ▷ Set the frequency of the UPL generator to 20 kHz.
- ▷ Use C44 to adjust to the reference, tolerance ±0.05 %.

Check: Check frequency response with 2 V, Output Unbal, channel 1 as described in the Performance Test, section 2.2.1.2, page 2.12.

3.2.1.3 100-kHz Adjustment Low Distortion Generator

NOTE:
Other adjustment procedures are not affected by this adjustment.

Test setup and setting of the UPL generator as before.

Adjustment:
- ▷ Switch on low distortion generator: `Low Dist` → `ON`
- ▷ Set the frequency of the UPL generator to 1 kHz.
- ▷ Measure AC, use the measured value as reference.
- ▷ Set the frequency of the UPL generator to 100 kHz.
- ▷ Use C500 to adjust to the reference, tolerance ±0.05 %
  (The trimmer is accessible through a hole in the screening panel, its position is marked by `C500 HF` on the screening panel).

Check: Check frequency response with 2 V, Output Unbal, channel 1 as described in the Performance Test, section 2.2.3.2, page 2.43.

3.2.1.4 DC-offset Adjustment

NOTE:
Other adjustment procedures are not affected by this adjustment.

Set the UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	1.0000 kHz
VOLTAGE	6.0000 V

Measuring instrument:
DC voltmeter

Test setup: Connect DC voltmeter to output of UPL generator.
To this end, an adapter from XLR female to 2*banana plug is required.

Switch off AC level:

In the OPTIONS panel under the menu item DIAGNOSTIC:
- Enter diagnostic password 1.4142
- Open diagnostic mode: Diag State → ON
- Switch off AC level: Enter DAC VoltAC → 0

Adjustment: Measure DC, use R390 to adjust to 0 ± 0.5 mV

Quit diagnostic mode: Diag State → OFF

Check: Check offset error as described in the Performance Test, section 2.2.1.4, page 2.13.

3.2.1.5 Adjustment of Output Balance

NOTE:
Other adjustment procedures are not affected by this adjustment.

Test setup as described in the Performance Test (See section 2.2.1.13, page 2.21).

Set the UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	BAL
Impedance	600 Ω
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	20.000 kHz
VOLTAGE	5.0000 V

Adjustment: Use R417 to adjust to minimum (< −75 dB)

Check: Check output balance as described in the Performance Test, section 2.2.1.13, page 2.21.

3.2.2 Hardware Adjustment Analog Analyzer

PREPARATION:
- ▷ Open UPL (see section 5.2.1.2, page 5.11).
- ▷ All adjusting devices are located on the analog unit and are easily accessible from the bottom of the instrument.
- ▷ In order to simplify operation of the UPL in this operating position it is recommended to connect an external monitor and an external keyboard.
- ▷ Switch on UPL.

Adaptation of the measuring instruments to the input of the analyzer is described in section 2.2.2 Performance Test Analog Analyzer, page 2.23.

The position of the adjusting devices is shown in the diagram Bottom View of UPL (section 5.2, page 5.13).

Before starting the hardware adjustment, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE` → `Mode` → `DEF SETUP`.

3.2.2.1 Adjustment of Frequency Response

NOTE:
In the case of the UPL analyzer, only the frequency response of the antialiasing lowpass in the instrument ANLG 110kHz is adjusted. The frequency response of the input dividers is adjusted with the adjustment of common-mode rejection. Since the signals of CH1 and CH2 are applied to the input of the 110-kHz ADC in multiplex mode, there is only one antialiasing filter. Therefore, it is sufficient to adjust only one channel.

CAUTION:
Following this adjustment, the correction factor for the level accuracy of the instrument ANLG 110kHz must be redetermined! However, the effect makes itself felt only in the case of a huge preceding misadjustment of the frequency response. See section 3.3.3, page 3.18.

Set UPL:

Analyzer	
INSTRUMENT	ANLG 110kHz
Channel(s)	1
Impedance	200 kΩ
Range	FIX: 3.0 V
FUNCTION	RMS
Unit	V/Vr
Reference	VALUE *)

*) set according to test report

Measuring instrument:

UPD generator:
- Sinewave, Channel(s) 2 ≡ 1,
- Output BAL,
- Impedance 10 Ω, Common GROUND,.
- FUNCTION SINE, Low Dist OFF,
- FREQUENCY see adjustment measurement,
- VOLTAGE 3 V

AC voltmeter

Test setup: Connect AC voltmeter to output of UPD generator:
To this end, use adapter 2*banana plug/BNC socket, BNC cable and adapter BNC socket/XLR plug.
Connect the XLR input CH1 of the UPL to the other output of the UPD generator via an XLR cable.

Measurement: Set UPD generator and UPL analyzer as above.
Set generator frequency 100 Hz → reference frequency.
Measure the actual value of the input voltage using the AC voltmeter.
Reference is the voltage measured at 100 Hz:
→ enter as RMS reference for CH1 in the analyzer panel.
Read off the UPL ratio display in V/Vr → V_{100Hz}.
Set generator frequency 20 kHz.
Measure the actual value of the input voltage using the AC voltmeter.
Reference is the voltage measured at 20 kHz:
→ enter as RMS reference for CH1 in the analyzer panel.
Read off the UPL ratio display in V/Vr → V_{20kHz}.

Adjustment: Use C23 to adjust such that the ratio V_{20kHz} complies with the ratio V_{100Hz} with an accuracy of ±0.0005. (= tolerance ±0.005 dBr)

3.2.2.2 Adjustment of Common-mode Rejection

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1 ≡ 2
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
VOLTAGE	3 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Impedance	200 kΩ
Common	GROUND
Range	FIX: *)
FUNCTION	RMS SELECT
Unit	dBr
Reference	VALUE 3 V
Bandwidth	BP 3 %
FREQ MODE	FIX: *)

*) set according to adjustment measurement

Measuring device:
Test cable for common-mode rejection

see section 2.1, page 2.1

Test setup: Connect the test cable for common-mode rejection to the XLR input of the UPL to be tested. Connect the BNC end of the cable to the output of the UPL generator via adapter BNC/XLR socket.

Measurement: Set UPD generator and UPL analyzer according to table.
Set generator frequency and analyzer range according to table and read off level display. The respective display value with opposite sign is the current common-mode rejection.

Range	Frequency	Adjustment	Channel	Internal function
3 V	1kHz	R278	1	Differential amplifier
	16kHz	C517	1	
	1kHz	R212	2	
	16kHz	C493	2	
6 V	1kHz	R218	1	10 dB Input divider
	16kHz	C57	1	
	1kHz	R169	2	
	16kHz	C159	2	
18 V	16kHz	C58	1	20 dB Input divider
	16kHz	C163	2	

Adjustment of common-mode rejection:

Adjust the measured value to minimum for each setting according to table. Start with the adjustment at 1 kHz, continue at 16 kHz for each channel. Make sure to observe the order; note that range 6 V must also be adjusted prior to range 18.
The adjustment procedures partly influence one another. In particular, the C-trimmers of dividers 10 dB and 20 dB require a repetition in order to reach the given minimum values.

3.2.3 Hardware Adjustment UPL-B1

Hardware adjustment of option UPL-B1, Low Distortion Generator, is described with the adjustment of the analog generator, see section 3.2.1.3, page 3.4.

3.2.4 Hardware Adjustment UPL-B2

PREPARATION:

- ▷ Open UPL (see section 5.2.1.2, page 5.11).
- ▷ Three adjusting devices are provided for the Option UPL-B2.
- ▷ The adjusting devices are to be found on the AES mainboard and on the front panel module. The rear panel module accommodates no adjusting devices.
- ▷ Potentiometer R13 on the front panel module is accessible from the left side of the instrument and from the top using a non-metallic screwdriver of the size 0.
- ▷ If the adjusting device for the Tx jitter amplitude (R246) is covered by a large 486-PC mainboard, it is necessary for the adjustment to remove the rear panel module and the built-in Audio Output Option UPL-B5 first and operate the PC mainboard via an adapter card (1006.6559.02) as it is supplied e.g. with the UPD Service Kit UPD-Z2 (1031.3208.02). To provide a better support of the PC mainboard for operation with the adapter card, it is useful to place a piece of stiff cardboard of the size of the adapter card underneath.
- ▷ In the case of a small PC mainboard, all adjusting devices are accessibe after removing the upper instrument panel.

▷ The position of the adjusting devices is shown in the diagram Top View of UPL (section 5.2, page 5.12).

Before starting the adjustment, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP`.

3.2.4.1 Level Adjustment of Digital Output

NOTE:
Other adjustment procedures are not affected by this adjustment.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	AUDIO DATA
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	48 kHz
Unbal Vpp	*)
BAL Vpp	*)
FUNCTION	SINE
FREQUENCY	1.0000 kHz
VOLTAGE	0.5000 FS

Analyzer †)	
INSTRUMENT	DIGITAL
Meas Mode	COMMON/INP
Input	*)
START COND	AUTO
Delay	0.0000 s
INPUT DISP	DIG INP AMP
FREQ/PHASE	OFF
FUNCTION	RMS & S/N
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

*) set according to adjustment instruction
†) Analyzer setting if Option UPL-B22 is installed.

Measuring instrument:
Oscilloscope

Test setup: Connect oscilloscope to UNBAL output of UPL with a 75-Ω cable and 75-Ω termination.
If the Option UPL-B22 is installed, connect the UNBAL output of the UPL to the UNBAL input using the 75-Ω cable.
The oscilloscope then serves for testing the adjusted amplitude.

Adjustment:

▷ Set level Unbal Vpp of the UNBAL digital output to 1.0000 V.
▷ Use R13 (TX AMPL) on the front panel module to adjust the output level on the oscilloscope to 1.00 V.
▷ If the Option UPL-B22 is installed, measure the level using the UPL analyzer and adjust to 1.00 V using R13, tolerance ±0.01 V.
▷ With this level, the measuring accuracy of the UPL analyzer for the pulse amplitude lies within the tolerance permissible for the output level of the digital generator.

Check: Check the level of the BAL digital output with BAL Vpp 4 V as described in the Performance Test, section 2.2.4, page 2.49.

3.2.4.2 Jitter Amplitude Digital Generator

NOTE:
Other adjustment procedures are not affected by this adjustment.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	JITTER
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	48 kHz
Sync Out	AUDIO IN
Type	BIPHASE CLK
Ref Out	REF GEN
Audio Bits	20
Unbal Vpp	1.0000 V
FUNCTION	SINE
Jitt Freq	1.0000 kHz
JittPkAmpl	0.5000 UI

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	INTERN
Jitter Ref	GEN CLK
INPUT/PHAS	FREQ
FREQ/PHASE	FREQ
START COND	AUTO
Delay	0.0000 s
FUNCTION	RMS & S/N
Meas Time	AUTO
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

Measuring instrument:

Modulation analyzer for phase modulation (for checking the measured values).

Test setup: Connect digital analyzer input to digital generator output (internal, BAL, UNBAL or OPTICAL).
Connect modulation analyzer to SYNC OUT.

Adjustment: ▷ Adjust the jitter amplitude (Input Peak display) to 0.500 UI using potentiometer R246 (TX Jitter) on the AES main board. Tolerance ±0.01 UI.

Check: Measure phase deviation at SYNC output of UPL using modulation analyzer: Carrier frequency 6.144 MHz, Phase deviation 3.14 rad (peak), tolerance ±0.3 rad (peak).

3.2.4.3 Reclock Function

NOTE:
Following this adjustment, perform a PhaseToRef adjustment in the OPTIONS panel under CALIBRATION DIG. Other adjustment procedures are not affected by this adjustment.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	JITTER
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	44.1 kHz
Sync Out	SYNC PLL
Type	BIPHASE CLK
Ref Out	AUDIO IN
Audio Bits	20
Unbal Vpp	1.0000 V
FUNCTION	SINE
Jitt Freq	1.0000 kHz
JittPkAmpl	0.0500 UI

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	INTERN
Jitter Ref	44.1 (PLL)
INPUT/PHAS	FREQ
FREQ/PHASE	FREQ
START COND	AUTO
Delay	0.0000 s
FUNCTION	RMS & S/N
Meas Time	AUTO
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

Measuring instrument:

Oscilloscope

Test setup:

Connect oscilloscope channel 1 to REF OUT using XLR/BNC adapter and BNC probe.
Connect oscilloscope channel 2 to SYNC OUT (using BNC probe or 75-Ω cable and 75-Ω termination).
Trigger the oscilloscope on channel 2.

Adjustment:

▷ Use potentiometer R249 (RECLOCK PHASE) to set the phase position of the jittered digital audio signal at channel 1 of the oscilloscope such that the rising edge of the SYNC output signal lies in the middle of the eye of the digital audio signal.

Check:

Set REF OUT output to AUD IN RCLK. The digital audio signal at channel 1 of the oscilloscope must not include visible jitter any more.
The REF OUT signal must not feature any disturbances even for jitter amplitudes up to at least 0.15 UI (peak) (typ. 0.45 UI).

3.3 Software Adjustment

3.3.1 Procedure

For adjusting certain parameters in the UPL, a procedure is used that is referred to as **software adjustment**: The deviation of the actual value from the nominal value is measured. This deviation (referred to as correction factor) is stored in the UPL and taken into account by the measurement software when controlling the analyzer and generator so that the error of the actual value remains within the tolerance.

The correction factors are stored in the UPL in an E^2PROM. This E^2PROM is accommodated on the analog unit. It can be read and written in diagnostic mode. Each time the UPL is switched on, a backup copy of the correction data in the E^2PROM is made on the hard disk. The backup files are to be found in the directory C:\UPL\REF.

There are four groups of correction data:

Group	Correction data for	Backup file
CAL LDG	Low Distortion Generator	LDG.CAL
CAL AGEN	Analog Generator	AGEN.CAL
CAL ANLR0	Analog Analyzer	ANLR0.CAL
CAL DIG PHS	Digital Generator UPL-B2 with -B22	DIG.CAL

These groups can be selected in diagnostic mode. The value of each individual correction factor can be displayed and modified. If the cursor is positioned in the input field 'Value', the permissible value range of the correction factor is displayed in the online help at the lower edge of the screen.

Calculation of the correction data for the analog generator and the analog analyzer is described in the subsequent sections software adjustment. For the low distortion generator, the digital generator and digital analyzer, automatically running routines are provided, which are called up in the OPTIONS panel of the UPL.

3.3.1.1 Diagnostic Mode

The diagnostic mode permits extensive interventions in the hardware of the UPL. Therefore, the diagnostic mode should only be used by authorized personnel of R&S representatives trained to do the service on the UPL.
In addition to entering the correction factors for the software adjustment, it is also possible, e.g., to read out and **modify** the hardware setting of all UPL modules. This also includes settings which are not used in normal measurement operation and which might cause damage to the hardware. In normal measurement operation of the UPL, the diagnostic mode is protected by a password. The password is 1.4142. It is entered in the OPTIONS panel in the line `DIAGNOSTIC password ?`.

Open diagnostic mode:
Enter the number 1.4142 in the OPTIONS panel in the line DIAGNOSTIC. The current setting of the UPL is stored. The new line Diag State OFF appears below DIAGNOSTIC. Select Diag State → ON in this line.

Quit diagnostic mode:
Select Diag State → OFF. The instrument setup stored when opening diagnostic mode is loaded again.

3.3.1.2 Software Adjustment Procedure

Analyzer and generator always use the currently valid correction factors stored in the E^2PROM. Before performing a correction measurement, the correction factor must be set to the value 1.
Before calling the automatic adjustment routines for the low distortion generator or the digital generator and analyzer, the respective correction factors need **not** be set to the value 1!

General procedure of a software adjustment:

1. Set old correction factor to 1:
   - Open diagnostic mode.
   - Select Board → E²PROM.
   - Select the desired CAL group as Device.
   - Enter the number of the correction factor as Address.
   - Enter the value 1 as Value.
2. Perform the correction measurement and calculate the new correction factor CF_{new}. Prior to a correction measurement, the DEFAULT SETUP of the UPL is loaded in most cases, causing the diagnostic mode to be terminated.
3. Enter new correction factor CF_{new} into the E²PROM:
   - Open diagnostic mode
   - Board → E²PROM
   - Select the desired CAL group as Device
   - Enter the number of the correction factor as Address
   - Enter the value CF_{new} as Value. The permissible value range is displayed in the online help at the lower edge of the screen.
   - Quit diagnostic mode

After a correction factor has been entered, it is **immediately** transferred to the E²PROM and becomes effective for the hardware. Next time the UPL is started, a backup copy of the correction data in the E²PROM is made on the hard disk, the old, previously valid correction data being overwritten. Before carrying out a software adjustment, the backup files of the correction data should therefore be stored again under a different name (e.g. by entering `copy *.cal *.old` in the directory C:\UPL\REF). Thus, it is possible to compare the old and the new correction data with each other.

3.3.1.3 Correction Factors in the E²PROM

- Settings in the OPTIONS Panel:

Diagnostic	Password ok	
Diag State	ON	
⋮		
Board	E²PROM	
Device	CAL LDG	= Correction data for the low distortion generator
	CAL AGEN	= Correction data for the analog generator
	CAL ANLR0	= Correction data for the analog analyzer
	CAL DIG PHS	= Correction data for UPL-B2 with UPL-B22
Address	Number of correction factor	
Value	Value of the correction factor selected with Address	

- Device = CAL LDG

Address	Value	Meaning
0	CF_ldg_sin	Sin Level (at 1V, 1kHz)
1	CF_ldg_imd	IMD Level (at 1V, 1kHz)
2	CF_ldg_frq[0]	Freq Range 0 (at 50kHz)
3	CF_ldg_frq[1]	Freq Range 1 (at 10kHz)
4	CF_ldg_frq[2]	Freq Range 2 (at 1kHz)
5	CF_ldg_frq[3]	Freq Range 3 (at 100Hz)

- Device = CAL AGEN

Address	Value	Meaning
0	CF_dac_sin	Gen Analog Level (at 1V, 1kHz)

- Device = CAL ANLR0

Address	Value	Meaning
0	CF1_NOTCH_RG0	Notch Freq Range 0, Ch 1 (at 20kHz)
1	CF1_NOTCH_RG1	Notch Freq Range 1, Ch 1 (at 3.2kHz)
2	CF1_NOTCH_RG2	Notch Freq Range 2, Ch 1 (at 470Hz)
3	CF2_NOTCH_RG0	Notch Freq Range 0, Ch 2 (at 20kHz)
4	CF2_NOTCH_RG1	Notch Freq Range 1, Ch 2 (at 3.2kHz)
5	CF2_NOTCH_RG2	Notch Freq Range 2, Ch 2 (at 470Hz)
6	CF1_AC_22	Level ANLG 22kHz, Ch 1 (at 3V, 1kHz)
7	CF2_AC_22	Level ANLG 22kHz, Ch 2 (at 3V, 1kHz)
8	CF1_AC_110	Level ANLG 110kHz, Ch 1 (at 3V, 1kHz)
9	CF2_AC_110	Level ANLG 110kHz, Ch 2 (at 3V, 1kHz)
10	CF_FREQ	Frequency (at 1kHz)
11	not used	cal_phas_fact
12	not used	cal_phas_offs

- Device = CAL DIG PHS

Address	Value	Meaning
0	dig_phase_cal_slope	slope of phase meter for positive phase
1	dig_phase_cal_offset	phase meter offset 0 grd
2	dig_phase_gen_slope	slope of phase generator
4	dig_phase_gen_offset	offset of phase generator
5	dig_phase_cal_slope_neg	slope of phase meter for negative phase

3.3.2 Software Adjustment Analog Generator

PREPARATION:

After performing the hardware adjustment, the UPL must be reassembled:

▷ Switch off UPL.

▷ Reinstall the low distortion generator (if removed before).

▷ Slide the lower instrument cover into place, turn the instrument upside down and replace the upper instrument cover.

▷ Fasten the rear-panel feet using screws (Phillips screwdriver, size 2).

▷ Switch on UPL.

CAUTION:
Before starting the measurements for calculation of the correction factors allow the UPL to warm up for at least 1 hour.

3.3.2.1 Level Adjustment Analog Generator

CAUTION:
The LF adjustment lowpass 23 kHz must have been performed!
See section 3.2.1.1, page 3.2.

Before starting the correction measurement, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP`.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
FREQUENCY	1.0000 kHz
VOLTAGE	1.0000 V

Measuring instrument:
AC voltmeter

Test setup: Connect AC voltmeter to output of UPL generator.
To this end, an adapter XLR female to 2*banana plug is required.

Adjustment:

▷ In the OPTIONS Panel under the menu item DIAGNOSTIC:
- Enter diagnostic password 1.4142
- Open diagnostic mode: Diag State → ON

▷ Set the old correction factor to 1:
- Board → E^2PROM
- Device → CAL AGEN
- Address → 0
- Value → 1.0000

▷ Measure AC, the measured value is U_{act}

▷ Calculate the new correction factor
$CF_{new} = 1.0000/U_{act}$
and enter in the line Value: Value → CF_{new}

▷ Quit diagnostic mode: Diag State → OFF

Check: The AC voltmeter must now display 1.0000 ± 0.001 V.

3.3.2.2 Automatic Adjustment Low Distortion Generator

The adjustment of the low distortion generator does not require any measuring equipment. The output signal of the generator is measured by the UPL analyzer via the internal connection from the generator to the analyzer in an automatically running routine. Then, the correction factors for the level and frequency accuracy are calculated and entered into the E^2PROM if they lie within the tolerance.

Level accuracy: Adjustment **relative** to the analog generator at 1.000 V, 1.000 kHz.

Frequency accuracy: Adjustment **absolute** at 100 Hz, 1 kHz, 10 kHz and 50 kHz.

CAUTION:
The level accuracy of the UPL analog generator must be within the tolerance at 1.000 V, 1.000 kHz. The frequency measurement of the UPL must be within the tolerance from 100 Hz 50 kHz.

NOTE:
The error of the level measurement of the UPL analyzer does not affect the adjustment measurement. The frequency measurement in the UPL analyzer is by the factor 100 more accurate than the frequency accuracy of the low distortion generator.

- Calling the adjustment routine in the OPTIONS panel by selecting the menu item `CALIBRATION GEN` → `LOW DIST` → `ONCE`

  CAUTION:
  Before calling the adjustment routine, the UPL must be allowed a warm-up time of at least 1 hour with closed casing. During the adjustment, no cables may be connected to the outputs of the generator and the inputs of the analyzer.

- Checking after the adjustment
  - ▷ Level accuracy at 1 V, 1 kHz, Output Unbal, Channel 1.
  - ▷ Frequency accuracy

  The measurements are described in section 2.2.3 Performance Test UPL-B1, starting at page 2.42

- Error messages during automatic adjustment

  1. `Calibration setup not found,`
     `calibration data unchanged.`

     The file CAL_LDG.SET in the directory C:\UPL\SETUP with the setting data of generator and analyzer for the automatic correction measurements of the Low Distortion Generator is faulty or not available.

     → install UPL Software again!

  2. `Tolerance file not found or data invalid;`
     `calibration data unchanged.`

     The file `LDG.TOL` in the directory C:\UPL\REF with the tolerances of the correction factors is faulty or not available.

     → install UPL Software again!

3. `Calibration Measurement failed,`
   `calibration data unchanged.`

   Correction measurement(s) faulty:

   → Repeat adjustment

   → Perform the checks, as described below.

4. `Calibration data out of tolerance;`
   `calibration data unchanged.`
   `See file LDG_ER.CAL in directory REF`

   One or more correction factors are out of tolerance. The deviation of the actual value from the nominal value is so big that there must be a hardware error.

   → Repeat adjustment

   → Replace Low Distortion Generator

   → Perform the checks, as described below.

- Troubleshooting on occurrence of error 3:

  Since the measurement could not be performed, a major error must be involved. Therefore, first check whether the UPL really functions properly with the low distortion generator switched off (Low Dist OFF in the Generator Panel):

  Check analyzer: Level measurement at 1 V, 1 kHz, Frequency measurement from 100 Hz to 50 kHz.

  Check generator: Level accuracy at 1 V, 1 kHz.

  Internally switch the analyzer to the generator output (to this end, set in the Analyzer Panel: Channel(s) 2 ≡ 1, Input GEN CROSSED) and check whether the generator signal is properly measured in both channels.

  If everything is okay so far, either the low distortion generator or the cable connection between low distortion generator and analog unit or the signal switchover on the analog unit is faulty.

  Before starting further troubleshooting, set the UPL to a defined initial status.
  To this end, call the default setting in the FILE Panel under the menu item
  `LOAD INSTRUMENT STATE` → `Mode` → `DEF SETUP`.

  Check that `Low Dist ON` is set in the Generator Panel.

  Check the output signal of the low distortion generator using an oscilloscope:

  ▷ At pin 10 of relay K240 on the analog unit
    - Signal applied: relay K240 or control faulty
      ⇒ Replace analog unit
    - No signal: continue troubleshooting:

  ▷ At test point P21 on the low distortion generator (remove screening cover on the component side using Phillips screwdriver size 1)
    - Signal applied: flat cable faulty.
      ⇒ Check the contacts of the plugs, replace cable.
    - No signal: low distortion generator faulty.

- Test on occurrence of error 4:
  - ▷ Level accuracy at 1 V, 1 kHz, Output Unbal, Channel 1.
  - ▷ Frequency accuracy at 100 Hz, 1 kHz, 10 kHz and 50 kHz.

  The measurements are described in section 2.2.3 Performance Test UPL-B1, starting at page 2.42.

  Evaluation of the measurements:
  - ▷ The frequencies 100 Hz, 1 kHz, 10 kHz are all in the same direction next to the nominal value, the frequency value 50 kHz is correct:
    ⇒ The temperature sensor on the analog unit is faulty.
  - ▷ In all other cases, the low distortion generator is faulty.

  Reason:
  As explained in section 4.6, page 4.16, the temperature dependence of the polypropylene capacitors for switchover of the frequency ranges of the low distortion generator is corrected by calculation. For this purpose, the temperature sensor is used. The highest frequency range (22 kHz to 110 kHz) includes an NP0 capacitor the temperature dependence of which is very small and therefore not corrected.

3.3.3 Software Adjustment of Analog Analyzer

PREPARATION:
If a hardware adjustment has been performed before, the UPL must be reassembled:

- ▷ Switch off UPL.
- ▷ Replace the lower and upper instrument cover.
- ▷ Fasten the rear-panel feet using screws (Phillips screwdriver, size 2).
- ▷ Switch on UPL.

CAUTION:
Before carrying out a software adjustment, it is usually not necessary to perform a hardware adjustment. Exception: Level adjustment Instrument ANLG 110kHz must be okay (→ see below)!
Before starting the adjustment measurements for determination of the correction factors, the UPL must be allowed to warm up for at least one hour with closed casing.
The ambient temperature must be in the range 23 ±10 °C.

3.3.3.1 Adjustment of RMS Level Measuring Accuracy

Before starting the adjustment measurement, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE — Mode — DEF SETUP`.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1
Output	UNBAL
Impedance	10 Ω
FUNCTION	SINE
Low Dist	OFF
VOLTAGE	3 V

Analyzer	
INSTRUMENT	ANLG 22kHz ANLG 110kHz *)
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 3.0 V
FREQ/PHASE	FREQ
FUNCTION	RMS
Unit	V/Vr
Reference	VALUE *)

*) Set according to adjustment measurement

Measuring instrument:
AC voltmeter

Test setup: Connect AC voltmeter to output of UPL generator:
To this end, use adapter 2*banana plug/BNC socket, BNC cable and adapter BNC socket/XLR plug.

Adjustment measurement for the 2 analyzer instruments and both channels: Corresponding correction factors CF1_AC_22, CF2_AC_22, CF1_AC_110 and CF2_AC_110 for AC level 3 V at 1 kHz and input addresses 6 to 9 see section 3.3.1.3, page 3.14.

Adjustment:

▷ In the OPTIONS panel under the menu item DIAGNOSTIC:
  - Enter diagnostic password 1.4142
  - Open diagnostic mode: Diag State → ON

▷ Set the old correction factor to 1:
  - Board → E²PROM
  - Device → CAL ANLR0
  - Address → 6 - 9
    enter an extra address for each correction factor, see section 3.3.1.3, page 3.14.
  - Value → 1.0000

▷ Measure AC voltage using voltmeter; the measured value is $U_{a(ref)}$: enter this value as reference in the analyzer panel under Reference → VALUE.

▷ Read off the new correction factor as analyzer display
$CF_{new} = U_{a(act)}$
and enter in the OPTIONS panel in the line Value → CF_{new}:

▷ Quit diagnostic mode: Diag State — OFF

Check: Adjusting voltage and frequency of the UPL generator are uncritical for the analyzer adjustment. However, the generator values are to be checked for correct functioning using the voltmeter and the UPL frequency display!
The RMS display of both analyzer channels must now read:
1.0000 ±0.001 V/Vr.

3.3.3.2 Adjustment of Frequency Measuring Accuracy

CAUTION:
The adjustment assumes correct functioning of the UPL generator with respect to level and frequency (see section 3.2.2.1, page 3.6).

Before starting the adjustment measurement, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP.`

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	1≡ 2
Output	UNBAL
FUNCTION	SINE
Low Dist	OFF
VOLTAGE	3 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	1
Input	GEN CH2
Range	FIX: 3.0 V
FREQ/PHASE	FREQ
Unit	f/fr
Reference	VALUE *)
FUNCTION	RMS

*) Set according to adjustment measurement

Measuring instrument:
Frequency counter

Test setup: Connect frequency counter to output of UPL generator:
To this end, use BNC cable and adapter BNC socket/XLR plug.

Adjustment measurement for analog analyzer: Corresponding correction factor CF_FREQ for frequency at 1kHz and input address 10, see section 3.3.1.3, page 3.14.

Adjustment:

- ▷ In the OPTIONS panel under the menu item DIAGNOSTIC:
  - Enter diagnostic password 1.4142
  - Open diagnostic mode: Diag State → ON
- ▷ Set the old correction factor to 1:
  - Board → E^2PROM
  - Device → CAL ANLR0
  - Address → 10

  - Value → 1.0000
- ▷ Measure generator frequency using frequency counter, the measured value is $f_{a(ref)}$:
  enter this value as reference in the analyzer panel under FREQ → Reference → VALUE.
- ▷ In the OPTIONS panel under the menu item DISPLAY:
  - Read Resol → CHOICE ...
  - Set frequency display 6-digit
- ▷ Read off the new correction factor as analyzer frequency display
  $CF_{new} = \mathrm{f}_{a(act)}$
  and enter in the OPTIONS panel in the line Value → CF_{new}:
- ▷ Quit diagnostic mode: Diag State → OFF

Check:

Adjusting voltage and frequency of the UPL generator are uncritical for the analyzer adjustment. However, the generator values are to be checked for correct functioning using the frequency counter and the UPL level display! The analyzer frequency display must now read 1.000000 ±0.000010 f/fr corresponding to $\mathrm{f}_{ref}\pm 10$ ppm.

3.3.3.3 Adjustment of Analog Notch Filter

CAUTION:
The adjustment assumes that the UPL generator has been calibrated with respect to level and frequency (see section 3.2.2.1, page 3.6).

Before starting the adjustment measurement, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP`.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1
Output	BAL
FUNCTION	SINE
Low Dist	OFF
SWEEP	AUTO SWEEP
X Axis	FREQ
Spacing	Lin Points
Start	0.98 f/fr
Stop	1.02 f/fr
Points	50
VOLTAGE	3 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 3.0 V
FREQ/PHASE	FREQ
Unit	f/fr
Reference	VALUE: 3 V
FUNCTION	RMS
Unit	dBr
Filter	Anlg Notch ON
Notch	30 dB
(Gain)	(Auto)
Notch Freq	*)

set UPL:

Display	
OPERATION	CURVE PLOT
TRACE A	FUNC CH1
Scale	MANUAL
Spacing	LIN
Top	0 dBr
Bottom	-60 dBr
TRACE B	FUNC CH2
Scale B	EQUAL A
X-AXIS	
Unit	f/fr
Reference	f_{ref} *)
Scale	AUTO
Spacing	LIN

*) set according to adjustment measurement

Adjustment procedure for analog notch filter: Corresponding correction factors CF_NOTCH ... for both analyzer channels and input addresses 0 to 5, see section 3.3.1.3, page 3.14.

Adjustment:

▷ In the OPTIONS panel under menu item DIAGNOSTIC:

- Enter diagnostic password 1.4142
- Open diagnostic mode: Diag State → ON

▷ Set the old correction factor to 1:

- Board → E^2PROM
- Device → CAL ANLR0
- Address → 0 – 5
  enter an extra address for each correction factor, see section 3.3.1.3, page 3.14.
- Value → 1.0000

▷ Enter the reference value of the notch filter stop frequency at Ref Freq $f_{notch(ref)}$ in the generator panel. Likewise, enter this value as reference in the analyzer panel under FREQ → Reference → VALUE and in the display panel under X AXIS → Reference → VALUE.

▷ Start single sweep using the key [SINGLE]. After completion of the sweep:

- switch to graphics mode
- [o CURSOR] [SET TO] [MIN A] read out frequency: → $f_{(act)}(CH1)$
- [* CURSOR] [SET TO] [MIN B] read out frequency: → $f_{(act)}(CH2)$

▷ Read off the new correction factor as analyzer frequency display
$CF_{new} = f_{notch(act)}$
and enter in the OPTIONS panel in line Value → CF_{new}:

▷ Quit diagnostic mode: Diag State → OFF

Check:

Start the respective generator sweep again. The minimum of the respective notch filters must now lie at 1.000 ±0.001 f/fr of the reference frequency and < -35 dBr!

NOTE: The device-internal notch filter correction via the software is performed in the lowest frequency range Notch Freq Range 2 (from 10 to 470 Hz) with a temperature-dependent setting. The temperature dependence of the polypropylene capacitors for switchover of the frequency ranges is corrected by calculation. For this purpose, a temperature sensor on the analog unit is used.
The upper frequency ranges > 470 Hz to 22 kHz contain NP0 capacitors, the temperature dependence of which is very small and therefore **not** corrected.
On occurrence of temperature-dependent errors when adjusting the analog notch filters, the current internal temperature of the UPL can be read out in the OPTIONS panel in order to check the function of the sensor (see Diagnostic Mode → Board TEMPERATURE, → Device, open box at READ TEMP and type [ENTER], Value → actual temperature).

3.3.4 Software Adjustment UPL-B1

Software adjustment of option UPL-B1, Low Distortion Generator, is described with the adjustment of the analog generator, see section 3.3.2.2, page 3.16.

3.3.5 Software Adjustment UPL-B2

PREPARATION:
Following a hardware adjustment, the UPL must be reassembled:

▷ Switch off UPL.
▷ Reinstall PC main board, rear panel module and Audio Option UPL-B5 (if removed).
▷ Replace the instrument covers and fasten the rear-panel feet using screws (Phillips screwdriver, size 2).
▷ Switch on UPL.

CAUTION:
Before carrying out the software adjustment, the UPL must be allowed a warmup time of at least 15 minutes with closed casing.

PhaseToRef Adjustment

PROCEDURE:
In the PhaseToRef adjustment, both the phase meter and the phase generator are adjusted via the software for the frame phase shift between the digital signal at the front input/output and the REF input/output at the rear of the UPL. In the first step, the phase offset and the scaling factor for the phase meter are determined by applying a reference phase signal with 180° and one with 0° . In the second step, the phase generator is adjusted via the software in an internal loop measurement by respectively scaling the D/A converter for the phase setting on the AES main board. The individual correction factors are stored in a file.

Before starting the automatic adjustment, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
`LOAD INSTRUMENT STATE → Mode → DEF SETUP`.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	PHASE
PhaseToRef	0.0000 %FRM
Unbal Out	AUDIO OUT
Cable Sim	OFF
Sync To	GEN CLK
Sample Frq	48 kHz
Sync Out	GEN CLK
Type	WORD CLK
Ref Out	REF GEN
Data	ALL ZERO
Unbal Vpp	1.0000 V
FUNCTION	SINE
FREQUENCY	1000.0 Hz
VOLTAGE	0.5000 FS

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	JITTER/PHAS
Input	INTERN
Jitter Ref	GEN CLK
START COND	AUTO
Delay	0.0000 s
INPUT/PHAS	PHAS TO REF
FREQ/PHASE	SAMPLE FREQ
FUNCTION	RMS & S/N
Filter	OFF
POST FFT	OFF
SPEAKER	OFF

- Calling the adjustment routine in the OPTIONS panel by selecting the menu item
  `CALIBRATION DIG — PhaseToRef — ONCE`

- Checking after the adjustment
  - ▷ Checking the input/Ref phase shift

  The measurements are described in section 2.2.6.1 Performance Test UPL-B2, starting at page 2.56.

- Error messages during automatic adjustment

  1. `Calibration setup not found,`
     `calibration data unchanged.`

     The file CAL_DIG.SAC in the directory C:\UPL\SETUP with the setup data of digital generator and analyzer for the automatic adjustment measurements is faulty or missing.

     → Reinstall UPL software!

  2. `Tolerance file not found or data invalid;`
     `calibration data unchanged.`

     The file DIG.TOL in the directory C:\UPL\REF with the tolerances of the correction factors is faulty or missing.

     → Reinstall UPL software!

  3. `Calibration data out of tolerance;`
     `calibration data unchanged.`
     `See file DIG_ER.CAL in directory REF`

     Adjustment measurement faulty. The faulty data obtained in this adjustment measurement are to be found in the file DIG_ER.CAL in the directory C:\UPL\REF.

  4. `Calibration of phase generator failed`
     `(due to Lock-Error or phase measurement error).`

  5. `Calibration of negative phase measurement failed`
     `(due to Lock-Error or phase measurement error).`

     Adjustment of phase generator faulty. The PLL for clock recovery of the input or REF input had not locked in and therefore caused a false measurement.

     → Repeat adjustment!

     → Troubleshooting, see below.

- Troubleshooting on occurrence of error 3, 4, or 5:

  If the adjustment cannot be performed after repeated attempts, there is probably a hardware error. Therefore, first check whether phase generation and measurement function in principle.

  - ▷ Connect REF input to REF output (XLR cable).
  - ▷ Connect digital audio input to digital audio output (INTERNAL, BAL, UNBAL or OPTICAL).
  - ▷ First perform phase measurement using Generator Src Mode AUDIO DATA in order to check the phase meter at 0°.
  - ▷ Vary frame phase setting on digital generator using Src Mode PHASE and compare to the measurement result of the analyzer.

  If the frame phase setting cannot be varied, an error is involved on the AES main board (reference PLL, D/A converter for reference phase).

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Chapter 4
Theory of Operation

This section provides an overview of the interaction between the individual modules during the measurement or signal generation.

4.1 UPL

In its basic configuration, the UPL is a two-channel audio analyzer for measurements on analog interfaces. The analyzer features a frequency range of 10 Hz to 110 kHz, the generator 2 Hz to 21.75 kHz.

The basic instrument consists of five main modules:

1. Digital board
    - DSPs
    - Peripheral equipment of PC with
        - IDE controller for hard disc (HDD), floppy (FDD), parallel printer port (LPT1) and serial interfaces (COM1, COM2).
        - VGA controller for internal LC display and external monitor.
        - IEEE controller
    - Keyboard controller for
        - front-panel keyboard
        - Rotary knob
2. PC mainboard
3. Analog unit
    - Analog analyzer
    - Analog generator
    - E^2PROM with instrument data
    - Temperature sensor
4. Power supply
5. Front module
    - LC display with illumination
    - Keyboard and rotary knob
    - Analog inputs and outputs (XLR adapter)

The digital modules are accommodated in the upper part of the instrument, the analog unit in the lower part, the power supply is to be found at the left side panel.

The basic instrument can be extended by the following options:

1. UPL-B1, Low Distortion Generator
   - RC oscillator, extends the frequency range of the analog generator to 110 kHz (only for sinewave).
   - Installation on the analog unit above the analog generator.
2. UPL-B2, Digital Audio I/O
   - Enables the measurement and signal generation on digital interfaces.
   - Consists of three modules:
     - The AES main board is plugged onto the digital board.
     - The front panel module (with the inputs and outputs for the digital audio signal) is installed in the front module.
     - The rear panel module (with the inputs and outputs for SYNC and REF) is mounted in the digital unit at the rear panel.
3. UPL-B5, Audio Monitor
   - For analog and digital input signals.
   - Including speaker and headphones jack.
   - Installation at the right side panel above the digital board, the headphone jack is mounted in the front module.

4.2 Analog Unit / Overview

See circuit diagram of Analog Unit, sheet 1 (in Volume 2, Register 3)
The analog unit contains:

- Analog analyzer.
- Analog generator.
- An E^2PROM with the correction data for the analog hardware and other instrument data.
- A temperature sensor measuring the temperature inside the UPL.

NOTE:
Although accommodated on the same board, the circuit parts of generator and analyzer are, electrically, totally independent of each other.

The supply voltages for the generator and the analyzer are taken from the power supply to the analog unit via the 34-contact flat cable W3. The analyzer ground is connected to the chassis, contrary to the ground of the generator, i.e. the generator is of floating design. If the output of the generator is switched to balanced (Output BAL), there is a capacity of 2 nF between generator ground and chassis; if the unbalanced output (Output UNBAL) is selected, there is a capacity of about 22 nF.

The **analog generator** is connected to the digital board via the 26-contact flat cable W1. Five different groups of signals are transferred via this interface:

1. Control of D/A converter (DAC LINK)
2. Control of hardware setting (DATA LINK)
3. Data line for reading out the temperature sensor
4. Control lines for the E^2PROM
5. Jitter signal (GEN_AES) for the generator section of the option UPL-B2 with -B22

Due to the floating design of the generator, all data signals for the generator (group 1 and 2) are transmitted via optocouplers.

The **analog analyzer** is connected to the digital board via the 34-contact flat cable W2. Four different groups of signals are transferred via this interface:

1. Control of A/D converter
2. Control of hardware setting
3. Monitor signals of the two channels for the option UPL-B5 (Audio monitor)
4. Jitter signals (ANA1_AES and ANA2_AES) from the analyzer section of the Option UPL-B2 with -B22

4.3 Analog Unit / Analyzer

(see UPL block diagram)

4.3.1 Analog measurements

The UPL contains two analog instruments:

1. ANLG 22 kHz

   Depending on the magnitude of the test signals, the range is selected in the input section of the two test channels either manually or fully automatically:

   - Nominal range 18 mV...30 V, divided into 5-dB steps (applies to Analog Unit Board version 2.02 – 3.xx [1] resp. revision index 02.02 – 03.xx [2]).
     Level table for each analyzer channel:

[1] see OPTIONS Panel — VERSIONS — Anlg Board
[2] see bar code label

No.	Range Nominal value	Input divider	Input amplifier	Range amplifier
0	18 mV	0 dB	20 dB	25 dB
1 *	30 mV	0 dB	20 dB	20 dB
2	60 mV	0 dB	20 dB	15 dB
3 *	100 mV	0 dB	20 dB	10 dB
4	180 mV	0 dB	0 dB	25 dB
5 *	300 mV	0 dB	0 dB	20 dB
6	600 mV	0 dB	0 dB	15 dB
7 *	1 V	0 dB	0 dB	10 dB
8	1,8 V	0 dB	0 dB	5 dB
9 *	3 V	0 dB	0 dB	0 dB
10	16 V	–10 dB	0 dB	5 dB
11 *	0 V	–10 dB	0 dB	0 dB
12	18 V	–20 dB	0 dB	5 dB
13 *	30 V	–20 dB	0 dB	0 dB

*) with DC measurement only these ranges are used.

Following analog signal conditioning using a 2-channel audio A/D converter, the data are acquired at a sampling rate of 3.072 MHz. An analog 2nd-order lowpass filter preceding each A/D converter in conjunction with the steep-edged digital lowpass incorporated in the converter avoids aliasing problems. In the A/D converter, data reduction to the true output rate of 48 kHz is at the same time accomplished via the digital lowpass. The analog digital converter operates according to the delta-sigma principle with a resulting resolution of 20 bits. The digital data stream is serially read into the DSP with the 2-channel information for further digital signal processing (data limit is 64 bits per conversion cycle for both analog channels).

2. ANLG 110 kHz

   Analog signal conditioning as with instrument ANLG 22 kHz.

   The data acquisition is performed after analog signal conditioning with a high-speed A/D converter at a sampling rate of 307.2 kHz. A steep-edged 9th-order analog lowpass connected ahead of the A/D converter is used to avoid aliasing problems.

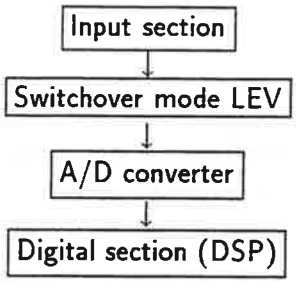
   The 14-bit sampling converter operates according to the principle of successive approximation. The digital data stream is serially read into the DSP with 4.9152 MHz for further signal processing, corresponding to 16 times the sampling rate. The A/D conversion and the digital further processing are performed sequentially for both analog channels (contrary to the instrument ANLG 22 kHz with parallel processing).

For differences in signal processing for the two analyzer models in the DSP: see digital measurements, section 4.5.3, page 4.14.

4.3.2 Driect Measurement with A/D-Converter

Special analog pre-processing is not used in the measurements of level, FFT, DFD-d3, wow & flutter, polarity test, frequency, phase and group delay.
After selecting the appropriate range for the test signal, the analog signals are band-limited by analog aliasing filters and by an additional digital filter in the audio ADC with ANLG 22 kHz. Further

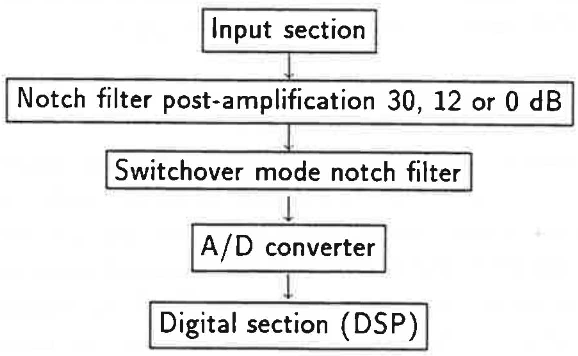
processing for the modes of measurement mentioned is performed by means of direct digital signal processing in the DSP after A/D conversion (see section 4.5.3, page 4.14).
Signal flow:



4.3.3 Measurement of: THD, THD+N, MOD DIST

A FAST and a PRECISION mode are provided for each of these modes of measurement. In the FAST mode, the analog signal conditioning is accomplished as with level measurement with subsequent direct digital signal processing in the DSP with the respective measurement routines. The PRECISION modes use subsequent pre-processing via an analog notch filter and subsequent range selection for the analog signal in order to improve the dynamic range of the signal for the A/D converter. The PRECISION modes with two successive measurement routines thus considerably improve the measurement dynamic, however, the measuring time is longer compared with the FAST modes.

- THD, THD+N:
  - FAST mode: Cycle similar to level measurement, the rms value and, at the same time, the fundamental frequency as well as the distortion factors of the signal to be weighted being determined in the DSP. The measurement is finished; the measured value is output.
    Signal flow of FAST cycle: as with level measurement (see section 4.3.2, page 4.4)
  - PRECISION mode: In this case, the first cycle (corresponds to FAST mode) is automatically followed by a second cycle with the analog notch filter cut in, which is set to the fundamental frequency with a post-amplification of up to 30 dB (automatic grading into 30, 12, 0 dB depending on the magnitude of the distortion signals - see block diagram with the stages 30, +12 or 0 dB, relative to test path LEVel – 6 dB). In the processed signal, the fundamental is equal to or smaller than that of the original signal, however, the harmonic distortions and noise are amplified by up to 30 dB.
    Signal flow of second cycle (Precision):



Result of second cycle:

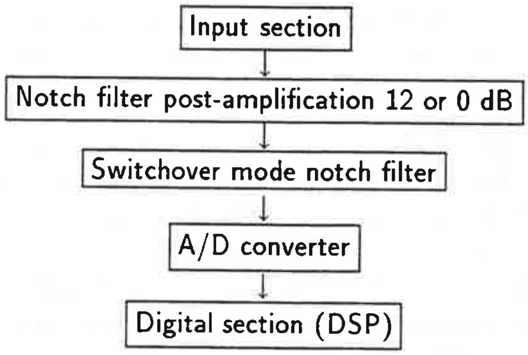
The DSP again determines the distortion factors from the analog- weighted signal. In this case, THD, THD+N are output as measured value, a different range being selected due to the post-amplification of up to 30 dB.

- MOD DIST:
  - FAST mode: Cycle similar to level measurement, in which the DSP determines the levels and frequencies of the interfering AF carrier and the higher-frequency carrier and, at the same time, the intermodulation factor of the signal to be weighted. The measurement is finished, the measured value is output.

    Signal flow of FAST cycle: as with level measurement (page 4.3)
  - PRECISION: Depending on the measurement result of the first cycle (corresponds to FAST mode) the following cases are distinguished:
    - ▷ MOD DIST is worse than –55 dB or $\geq$ 0.18 % with ANLG 22 kHz, (–40 dB or $\geq$ 1 % with ANLG 110 kHz): The measurement is finished, the measured value is output.
    - ▷ MOD DIST is better than –55 dB or $<$ 0.18 %with ANLG 22 kHz, (–40 dB or $<$ 1 % with ANLG 110 kHz):

      In this case, the first cycle (corresponds to FAST mode) is automatically followed by a second cycle with an analog notch filter cut in, which is set to the frequency of the interfering AF carrier with a post-amplification of 12 dB or 0 dB, depending on the ratio between interfering level and RF level. In the processed signal, the interfering level of the intermodulation signal is smaller than that of the original signal, the modulated RF carrier, however, is amplified by max. 12 dB (for level ratios of 4:1).

    Signal flow of second cycle (Precision):



Result of second cycle:

The DSP again determines the intermodulation factor from the analog- weighted signal. The MODDIST value is output as measured value.

4.3.4 Measurement of DFD-d2

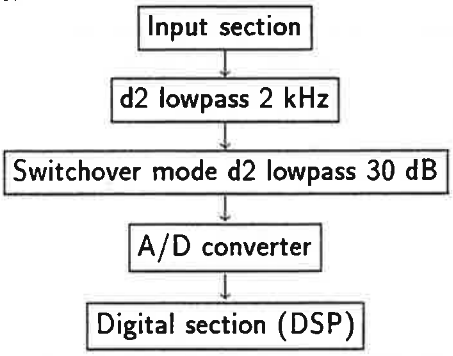
As with the distortion measurements described above, the two modes FAST and PRECISION are available for this type of measurement. In the case of FAST, analog signal processing is similar to level measurement with subsequent direct digital signal processing in the DSP with the corresponding measurement routine. The PRECISION mode uses subsequent pre-processing via an analog lowpass filter and post-amplification of the analog signal by 30 dB to improve the dynamic range of the signal for the A/D converter. The PRECISION mode with two successive measurement routines thus considerably improves the dynamic range, however features a longer measuring time than the FAST mode.

- FAST mode: Cycle similar to level measurement, the DSP determining the levels and frequencies of the two differential-tone carriers of the signal to be weighted. The measurement is finished; the measured value is output.

  Signal flow of FAST cycle: as with level measurement (see page 4.3)

- PRECISION mode: Depending on the measurement of the first cycle (corresponds to FAST mode) the following cases are distinguished:
  - ▷ DFD-d2 is worse than –50 dB or ≥ 0.316 %: In this case, the measurement is finished, the measured value is output.
  - ▷ DFD-d2 is better than –50 dB or < 0.316 %: In this case, a second cycle is automatically performed with the d2 lowpass filter 2 kHz selected and with a post-amplification of 30 dB (relative to LEVel mode). In the processed signal, the differential-tone carriers are equal to or smaller than those of the original signal, the 2nd-order differential tone and other noise, however, are amplified by 30 dB.

    Signal flow of second cycle:



    Result of second cycle:
    The DSP again determines the differential-tone factor from the analog-weighted signal. In this case, DFD-d2 is output as measured value, a different range being selected due to the analog post-amplification by 30 dB.

4.3.5 Inputs and Outputs for UPL Options

To permit analog functions to be used in conjunction with UPL options, the two analyzer channels contain an additional input and output each.

- Input for demodulator signal of the Option Digital Audio I/O:

  The input is DC-coupled. The level range is permanently set to 0 - 3 V, with a defined nominal value (applies to Analog Unit Board version 2.02 – 3.xx[3]) resp. revision index 02.02 – 03.xx[4]).

  Depending on the choice made for the jitter measurement, the following signals are fed in and measured:

  - The jitter demodulator signal or the common-mode signal (common-mode amplitude) of the digital XLR inputs is applied to the analyzer channel CH1.
  - DC voltages derived from the jitter phase measurement or the peak detector for recording the digital input amplitude are applied to the analyzer channel CH2.

- Output for providing an analog input monitor signal for the Option Audio Monitor. The level range is 0 – 3 V, referred to the respective nominal range value of the analog analyzer.

[3] see OPTIONS Panel — VERSIONS — Anlg Board
[4] see bar code label

4.4 Analog Unit / Generator

See also block diagram Analog Unit / Generator
Drawing 1078.2908.01 S, Sheet 3 (Volume 2, Register 3)

- Signal generation using D/A converter
  All signals are generated by a $\Sigma\Delta$-D/A converter (DAC) with a resolution of 18 bits. This D/A converter is operated with a clock of 12.288 MHz (MCLK) generated by a crystal oscillator. A bit clock (BICK) of 3.072 MHz is generated by frequency division and transferred both to the D/A converter (DAC) and to the DSP on the digital board. From there, the 48-kHz word clock (LRCK) and the serial audio data (DATA) are returned synchronously with the bit clock. The balanced output signals DO+ and DO− of the D/A converter are synchronized with the crystal-based 12.288-MHz clock in a 1-bit latch (flip-flop). The spectral purity of this clock and the operating voltage of the 1-bit latch are decisive for the signal quality of the audio signal. The 12.288-MHz clock oscillator, the D/A converter and the 1-bit latch therefore each have their own +5-V supply voltage, derived from the +15-V supply on the board.

- Level accuracy
  The operating voltage for the 1-bit latch determines the level accuracy of the audio signal. The amplitude error caused by the tolerance of the voltage reference (± 1 %) is determined in a correction measurement and corrected by the software in the DSP when the signals are calculated (correction factor CF_dac_sin).

- Filter
  The balanced output of the D/A converter provides a high-frequency, pulse-width-modulated rectangle, the average of which is the audio signal. A differential amplifier filters the signal and renders it unbalanced. Then, all unwanted signal components above 21.75 kHz are suppressed by a steep-edged 23-kHz lowpass filter. At the output of this lowpass, all signals are set such that they feature a peak value of $\approx 3.54\ V$ (rms value 2.50 V for sinewave).

- Differential-tone highpass filter
  This highpass filter (HP DIFF) is only used for generation of differential-tone signals (generator function DFD) and improves the signal-to-noise ratio of the signal for frequencies < 1 kHz from 100 dB to 130 dB. The passband begins at 5 kHz.
  The highpass filter is not cut in
  - if DC Offset ON is selected in the generator panel
  - if the center frequency of the DFD signal is smaller than 5 kHz.

- Signal generation using the low distortion generator
  The low distortion generator is an RC oscillator which generates a very low-noise and low-distortion sinewave signal in the frequency range 10 Hz to 110 kHz with a constant level of $V_{rms} \approx 2.70\ V$. If a sinewave signal is involved, it can be cut in as signal source instead of the $\Sigma\Delta$-D/A converter by selecting `Low Dist` → `ON` in the generator panel. The function of this module is described in greater detail in section 4.6, page 4.16.

- Level Control
  Before being applied to the level control circuit, all signals feature a peak value of $\approx 3.54\ V$ (rms value 2.50 V for sinewave). When using the low distortion generator, the level is slightly higher, since the correction factor CF_ldg_sin can only be taken into account in the level control circuit by means of signal attenuation.
  The complete circuit has the effect of a multiplying D/A converter, which attenuates the signal

by up to 24 dB with a resolution of 16 bits. The maximum gain can be switched between 0 dB and 6 dB. The maximum level at the output of the circuit is 5 V.

- Level table

  The following level table is valid for the UNBAL output. For the BAL output, the voltage values in the first two columns of the table are to be doubled, since the output voltage is twice as high with an otherwise identical hardware setting.

  Except for the range marked with *) the level setting is the same for Low Dist ON and OFF.

Output voltage		Hardware setting		
Peak to Peak	Rms value (for sine)	Level Control	Output Amplifier V1	Output Attenuator
28.28 V – 14.14 V	10.0 V – 5.0 V	6 – 0 dB	6 dB	0 dB
14.14 V – 7.07 V	5.0 V – 2.5 V	6 – 0 dB	0 dB	0 dB
7.07 V – 3.535 V	2.5 V – 1.25 V	6 – 0 dB	–6 dB	0 dB
3.535 V – 1.77 V	1.25 V – 625 mV	6 – 0 dB	–12 dB	0 dB
1.77 V – 884 mV	625mV – 312.5 mV	0 – –6 dB	–12 dB	0 dB
884 mV – 442 mV	312.5 mV – 156.25 mV	6 – 0 dB	0 dB	–24 dB
442 mV – 221 mV	156.25 mV – 78.13 mV	6 – 0 dB	–6 dB	–24 dB
221 mV – 110 mV	78.13 mV – 39.06 mV	6 – 0 dB	–12 dB	–24 dB
110 mV – 55 mV	39.06 mV – 19.53 mV	0 – –6 dB	–12 dB	–24 dB
55 mV – 27.5 mV	19.53 mV – 9.77 mV	6 – 0 dB	0 dB	–48 dB
27.5 mV – 13.8 mV	9.77 mV – 4.88 mV	6 – 0 dB	–6 dB	–48 dB
13.8 mV – 6.9 mV	4.88 mV – 2.44 mV	6 – 0 dB	–12 dB	–48 dB
6.9 mV – 3.45 mV	2.44 mV – 1.22 mV	6 – 0 dB	–12 dB	–48 dB
3.45 mV – 424 µV	1.22 mV – 150 µV	0 – –24 dB	–12 dB	–48 dB
424 µV – 0	150 µV – 0	–24 dB	–12 dB	–48 dB *)

*) Level setting with Low Dist OFF:
The output voltage of the D/A converter is set to a lower level (by the DSP).
Level setting with Low Dist ON:
The output voltage of the low distortion generator is set to a lower level (the circuit IMD ATTEN is cut in and the voltage is attenuated).

- Output stage (output amplifier)

  The first output stage V1 is an inverting operational amplifier, the gain of which can be switched in four steps: +6 dB, 0 dB, –6 dB or –12 dB. The maximum output level is 10 V. With a level of about 0.3125 V, the 24-dB output attenuator is cut in, the voltage at the output of the output stage is again increased by 24 dB to 5 V.

  The second output stage V1 inverts the signal from the first one. The voltage **between** the outputs of the two output stages is thus twice as high (max. 20 V) as the signal at the output of the first output stage V1. This differential signal is applied to the output terminals as balanced signal if `Output BAL` is selected in the generator panel. If `Output UNBAL` is selected, only the output signal of the first output stage is used, which is why only half the level, compared with the balanced signal, is possible.

- Output attenuator

  The two-stage output attenuator attenuates the signal by 24 dB or 48 dB. The source impedance is 5 Ω with Output UNBAL and 10 Ω with BAL. The signal at the attenuator input is max. 5 V.

- Channel switchover, impedance switchover
  Following the output attenuator, the signal can either internally be applied (as signal source for jitter generation) via the digital board to the option UPL-B22 or taken to the XLR outputs on the front panel. Following this switchover, the signal is split up into two output channels (channel 1 and 2). The two channels are of identical design:
  - One relay each for switching on/off the channel.
  - Two relays each for switching over the impedances (only for the BAL output).
  - One relay each for switching between UNBAL and BAL output.

- Current limiting
  The output of the generator is short-circuit-proof. The maximum output current is limited to about 200 mA in the output stages. In the case of a continued short-circuit, the generator output is switched off (high-impedance).

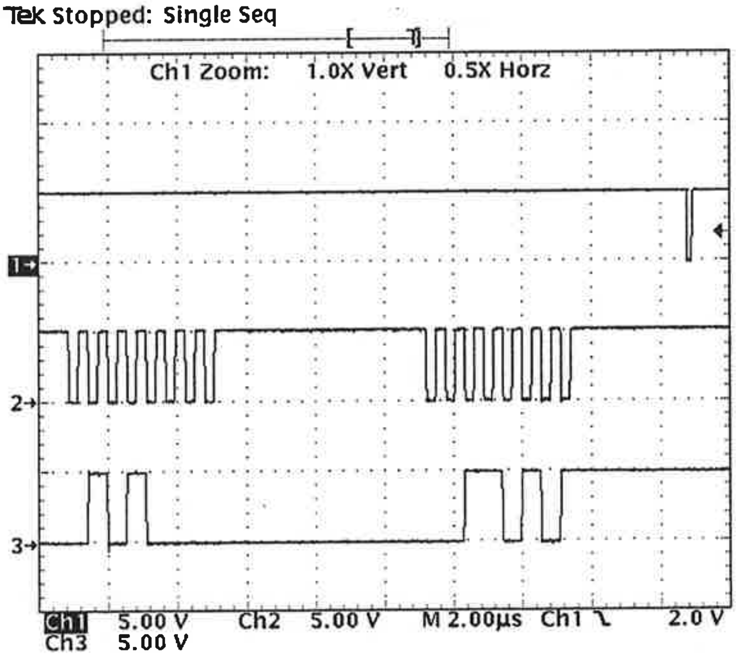
- Overload detector and overload interrupt
  A window comparator monitors the voltages at the inverting inputs of the two output stages. If there is an overload at one of the output stages (e.g. due to a short-circuit at the output), the window comparator is triggered and sets the overload interrupt flip-flop, which, in turn,
  - switches off the relay drivers, causing the generator output to become high-impedance,
  - signals this status via interupt (GENINT) to the digital board.

- Signal generation with DC offset
  The entire generator is DC-voltage-coupled from the D/A converter to the output, i.e. there is no lower limit frequency. The signal is calculated in the DSP together with the DC offset. Due to the superimposed DC component, the AC component of the D/A converter signal must be reduced. This causes the signal-to-noise ratio of the AC signal to deteriorate.

- Serial data interface: DATA LINK IN and OUT

Signal		Function
GCLK	Clock	Shift clock for the data. The data are shifted in blocks of 8 bits each on the rising edge. Data change with the falling edge.
IAIDO	Data in	Serial data stream, MSB first.
GDI	Data out	The data are returned to the digital generator
GWR	Write	Active 'Low', pulse width ≈ 200 ns, data are transferred from the shift registers into the latch.
WREN	Enable	'Low' during the system start, the generator output is high-impedance. 'High' when the software is running and the hardware is properly set.
GINT	Interrupt	Signals overload of the generator output (High = ok, Low = Overload)

The next illustration shows the transfer of the last two bytes before the GWR pulse. The scaling of the x axis is only an approximation. The correct timing depends on built-in PC mainboard.

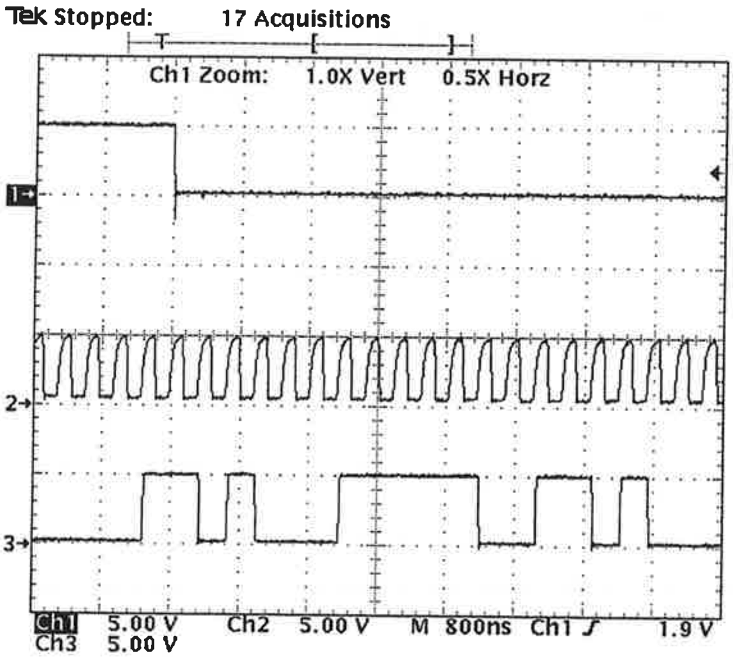


Trace1: GWR, Trace2: GCLK, Trace3: IAIDO

- D/A-converter interface: DAC LINK

Signal		Function
GLR	Left/right	48 kHz sample rate, comes from DSP
GBCLK	Bitclock	3.072 MHz shift clock for the data, transferred from the analog unit to the DSP. Data change with the rising edge.
GDATA	Audio data	Samples of the generator signal, calculated by the DSP.

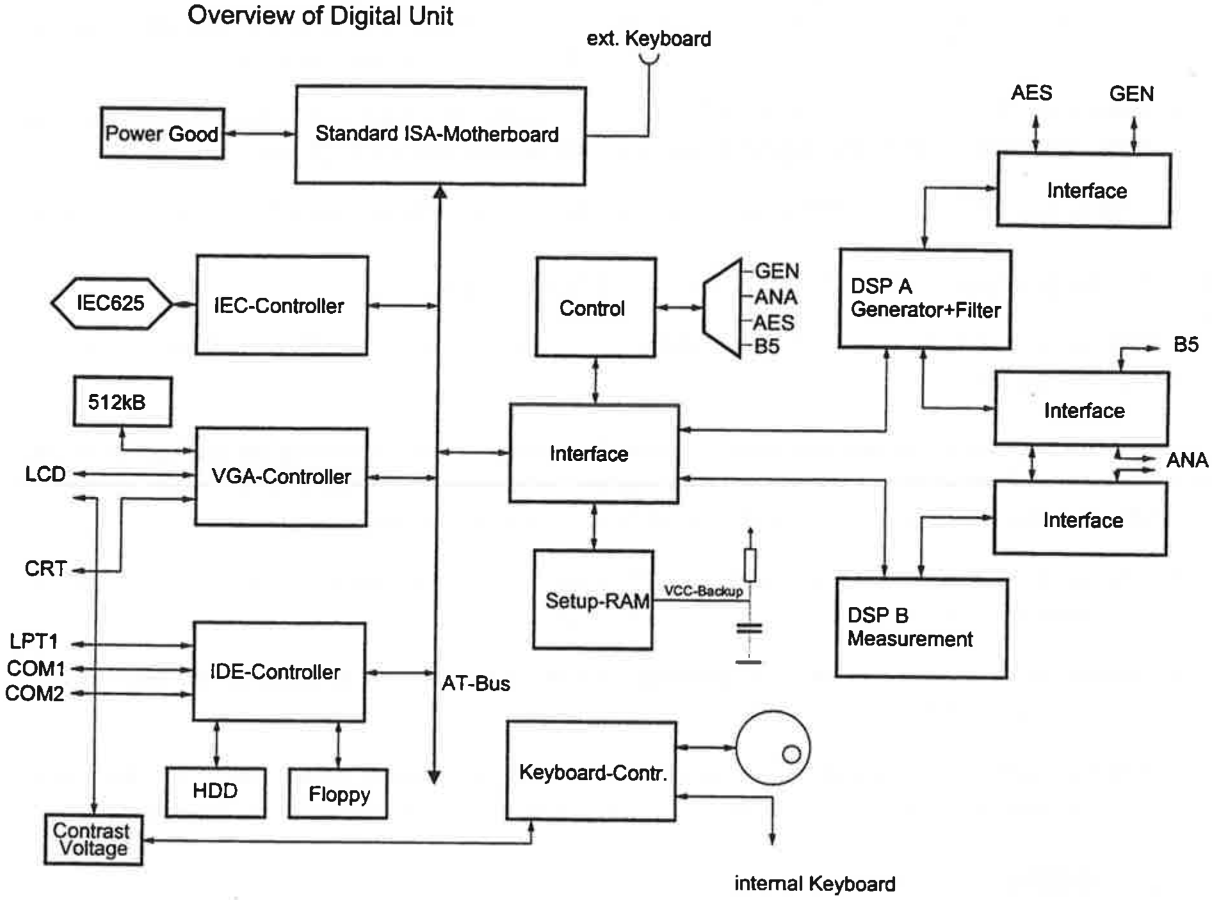
The next illustration shows these signals, measured on the analog unit at cable W1.



Trace1: GLR, Trace2: GBCLK, Trace3: GDATA

4.5 Digital Units

Overview of Digital Unit



4.5.1 Controller (PC)

A standard PC is used as controller; it consists of the following components:

- PC main board: this is a conventional PC motherboard, baby size or smaller, with integrated BIOS and at least one ISA slot.
- RAM: A PS/2 module, 72-contact, 1M*36 with parity is used. This module is inserted on the PC main board.
- AT Bus Adapter: This is a small board without components, which can be plugged into an ISA slot on both sides. This board is used to connect the PC main board to the digital board.
- Digital Unit, PC unit: The complete peripheral equipment of the controller is accommodated on the digital board. (The digital board and the adapter board (analog) are to be found on the digital unit due to manufacturing reasons.)
  - ▷ IDE controller: Controlling of the hard disk and floppy disk drive as well as of the two serial and the parallel interface.
  - ▷ VGA controller: for simultaneous operation of LCD and external monitor, resolution 640*480 pixels, 512-kbyte video RAM.
  - ▷ IEC controller: TNT488 from National Instruments is used.

- ▷ Reset generation: When the instrument is switched on, a defined reset pulse is generated, which is taken to pin 10 of the power connector of the PC main board.
- ▷ Contrast voltage generation: The negative bias voltage (about –22V, VEE) required for black-and-white LCD is derived from the +5 V by means of a digitally controlled voltage converter. The voltage converter is controlled by the keyboard controller.

- Hard disk: A 2.5" hard disk with IDE interface is used. The hard disk is mounted at the rear right and connected to the digital board via a 44-contact flat cable (1-mm spacing).

- Floppy disk drive: 3.5" HDD drive , controlled by the digital board via a 34-contact flat cable.

4.5.2 Interface AT - Measurement hardware

The interface is operated from the AT bus, where it occupies the addresses 390H to 393H. It consists of the following parts:

- Control logic for serial shift registers of analog hardware: When controlling the analog hardware, packages of up to 8 bits each are taken via the respective multiplexer path. If no control is effected, the complete logic circuitry is off (even the clock is switched off).

- Fast serial connection to the two DSPs. It is implemented by means of a gate array and is used both for starting and for operation of the DSP's.

- Control of the setup memory: It consists of CMOS-RAMs and is buffered by means of a capacitor with high capacity (gold cap).

- Keyboard controller: Evaluation of the front-panel keyboard and the rotary knob. The keyboard lines are only operated on actuation of the key; normally, the keyboard lines are unused.

4.5.3 DSPs

2 DSPs[5] are provided in the UPL, referred to as DSP A and DSP B, respectively, in the following. Signal processing in the UPL is divided up between these two DSPs as follows:

- Preprocessor, DSP A

  This DSP calculates the signals to be generated and outputs them to the analog generator or to the digital audio interfaces. At the same time, the input data from the analog analyzer or from the digital audio interface are read in and their input peak value is calculated. After calculation of the selected filters, the filtered samples are applied to the audio monitor option or to the DSP B. All internal audio signals are transferred as multiplexed L/R signals.

- Analysis Processor, DSP B

  The signal preprocessed by DSP A is analyzed in the DSP B with the selected measurement function. The data of the high-speed converter are directly read into the DSP B and not taken via the preprocessor.

After starting the instrument software, the following procedures are performed by the software:

[5] Digital Signal Processor, in the UPL TMS320C31

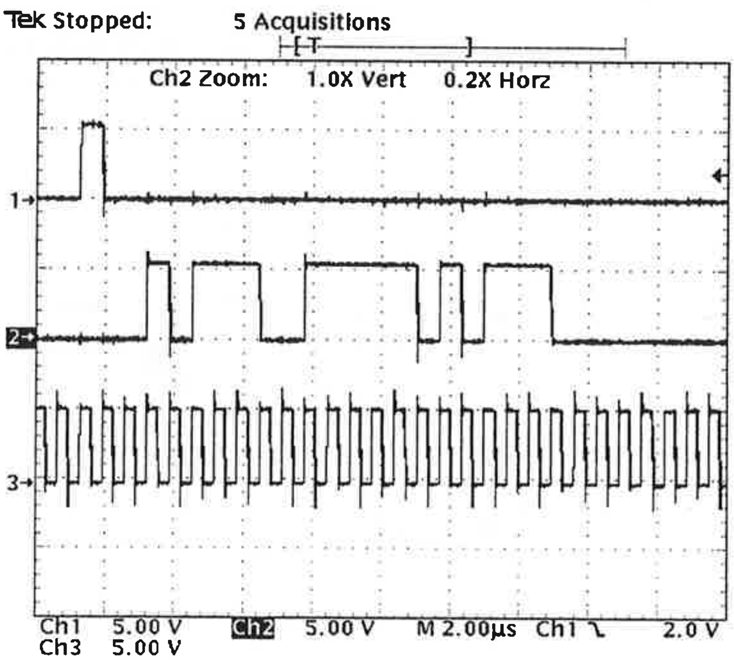
- The DSPs are booted.

  The ROM located in the DSP contains a program, which, depending on the status of the interrupt lines, starts a special boot routine. The serial boot is used in the UPL. The two DSPs can only be booted simultaneously.

  Boot procedure:

  – Switchover of the DSP to the micro-computer mode (BOOT = high): Thus the interrupt vectors are applied to the DSPs with D37.
  – Activation and deactivation of RESET: (DSP A: D30, Pin 17; DSP B: D30, Pin 16;). The DSPs start up, read in the interrupt vector and branch to serial boot mode.
  – Serial transfer of the DSP operating system (DUMP.OUT); Reception on serial interface 0 of the DSP. The file DUMP.OUT is entered at the address 100000H;
  – Switchover of the DSP to micro-processor mode (BOOT = low): Thus the interrupt vectors are enabled again and the memory at address 100000H is also available at address 0.
  – Further reset. Now the previously loaded program is started in the DSP and the DSP registers at the serial interface. If this process fails, the error message `Can't boot DSP ..` appears.

- After booting the DSP operating system, the respective application software is loaded. This is accomplished in high-speed serial mode with the 3 lines Data, Clock and Framesync. 32 bits are transferred per frame. The following diagram shows Framesync (FSX) in trace 1, Data in trace 2 (MSB first) and the associated clock in trace 3.



The file A.OUT is transferred to the DSP A, the file B.OUT to the DSP B.

- Within this application software, the respective test function or generator waveform is selected and executed by means of an interrupt or by polling with the selected input or output.

- The AT maintains in normal polling mode during all the interactions with the DSP. Exception: Picture data and FFT result vectors are transferred by means of DMA transfer (two 16-bit transmissions per serial transfer closely following each other).

  DMA channel 6 and interrupt 10 are used.

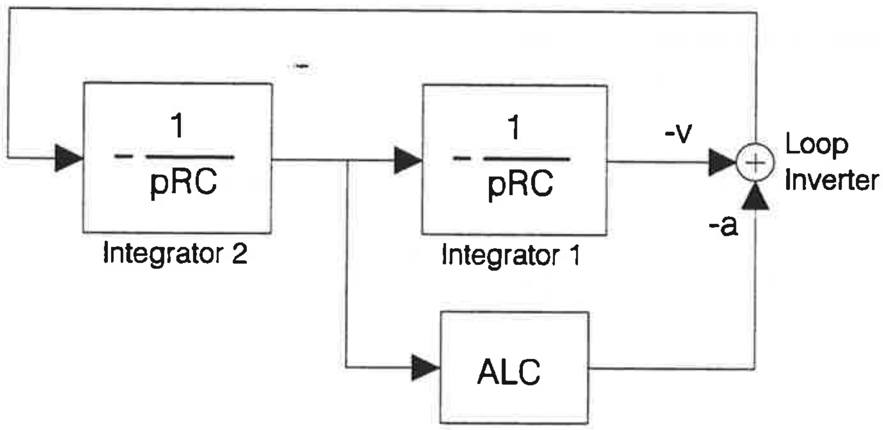
4.6 UPL-B1, Low Distortion Generator

See also block diagram Low Distortion Generator
Drawing 1031.2699.01 S, Sheet 1 (Volume 2, Register 5)

The low distortion generator is an RC oscillator generating a very low-noise and low-distortion sinewave signal in the frequency range 10 Hz to 110 kHz with a constant level of $V_{rms} \approx 2.70V$.
If a sinewave signal is involved, it can be activated as signal source instead of the $\Sigma\Delta$ D/A converter by selecting `Low Dist` → `ON` in the generator panel.

The module is mounted on the analog unit above the analog generator and connected to the analog generator via a flat cable.
A multiplexer on the analog unit connects the low distortion generator into the data stream for the hardware setting of the generator. On switch-on, the UPL automatically identifies the option. The software checks whether the data transferred to the generator for setting the hardware can be fed back. During this process, the version number of the board is simultaneously read out and displayed in the OPTIONS panel under the menu item OPTIONS in the line Low Dist.

The oscillator operates according to the principle of the state-variable oscillator:
Two integrators (integrator 1 and 2) are connected in series and are coupled back via an inverter (loop inverter). This causes a phase shift of 360°, the circuit oscillates. An automatic level control ensures a stable sinewave oscillation with a constant amplitude.



The oscillator frequency f is set by means of the time constant $1/RC$ of the integrators and the gain v of the inverter:

$$f = \frac{\sqrt{v}}{2\pi RC} \quad with \quad \sqrt{v} = \sqrt{0.98} = 0.99$$

The amplitude error caused by the tolerance of the voltage reference (±5 %) in the level control is determined in a correction measurement and corrected by the software when the level is set (correction factor CF_ldg_sin).
At the output of the oscillator, an amplifier can be added, which permits the level to be attenuated with a resolution of 12 bits (IMD ATTEN). This amplifier is only used when generating very low levels ($< 150\ \mu$V). The gain error with an attenuation of 0 dB is also measured in an adjustment measurement and corrected by the software (correction factor CF_ldg_imd).

The entire frequency range from 10 Hz to 110 kHz is subdivided into four ranges which can be switched over by capacitors. The frequency error caused by the tolerance of the four capacitors (±1 %) is determined by one correction measurement per range and corrected by the software when the frequency is set.
Within a range, the frequency is set by means of resistor R with a resolution of 16 bits. The tolerance of the resistor is ±0.1 %.

Frequency range	Correction factor	Frequency
110 kHz – 22 kHz	CF_ldg_frq[0]	50 kHz
22 kHz – 1.8 kHz	CF_ldg_frq[1]	10 kHz
1.8 kHz – 185 Hz	CF_ldg_frq[2]	1 kHz
185 Hz – 10 Hz	CF_ldg_frq[3]	100 Hz

In order to determine the correction factors described above an automatically running routine is available, which can be called up in the OPTIONS panel under the menu item `Calibration Low Dist`. No measuring equipment is required. See also section 3.3.2.2, page 3.16.

Due to the extremely high requirements placed on the distortion factor of the circuit, only capacitors with a dielectric consisting of NPO ceramics (up to about 10 nF) or polypropylene (up to about 1000 nF) can be used. Polypropylene features a temperature coefficient of typcially –250 ppm/K = –0.025 %/K. Increasing the temperature by 10 °Celsius would thus reduce the frequency by 0.25 %. The analog unit accommodates a temperature sensor which cyclically measures the temperature in the UPL. This information permits the software to consider the typical temperature coefficient of the capacitors: the value of the capacitor C in the above formula for calculation of the oscillator frequency is not constant, but temperature-dependent. Thus, the frequency drift versus the temperature can be clearly reduced.

4.7 UPL-B2, Digital Audio I/O

(cf. UPL block diagram)
The Option UPL-B2, Digital Audio I/O, permits the UPL to be connected to digital audio interfaces. Thus, the UPL provides all conventional interfaces such as XLR, BNC or the optical TOSLINK interface for digital audio generation and analysis. The option consists of a total of three modules, i.e. the AES Main Board, the Front Panel Module and the Rear Panel Module.

On the **front panel module**, the complete physical interface matching for the digital audio inputs and outputs is performed. The two outputs BNC and XLR can be set in their output level and the level measured at these two inputs via a rectifier. A long-cable simulator can be connected to the BNC and XLR output. Besides, a common-mode signal can be applied on the XLR generator side or analyzed at the XLR input. An input multiplexer selects the desired input for the digital audio decoder Rx1 on the AES Main Board. The digital outputs of the UPL are always available at the same time. The UNBAL output can also be used to output the input signal from the BNC or XLR input again, for example in order to view the eye diagram on an oscilloscope.

The **rear-panel module** accommodates the complete interface matching for the REF and SYNC inputs/outputs. The XLR REF inputs/outputs feature an impedance of 110 Ω, the SYNC inputs/outputs an impedance of 75 Ω. A digital audio signal is applied to the REF input if the generator or the analyzer is to be synchronized with this signal or if the phase between two AES signals is measured. The digital input signal can be output to the REF output again either directly or sampled with a low-jitter clock (reclocking). In addition, this output can also be connected to the internal reference generator or the digital generator. The output level of the REF output remains at approx. 4 V_{pp}. The word clock signal or the bi-phase signal of a selected source can be output at the SYNC output, the bi-phase clock signal featuring 128 times the sampling frequency. A composite video signal can also be applied to the SYNC input if the generator is to be synchronized with the video signal. The provided video sync separator filters the vertical sync signal, thus controlling the reference PLL.

The **AES Main Board** accommodates the digital audio coder and the digital audio decoder, the complete clock processing for the generator, the reference PLL, the jitter modulator and the jitter demodulator as well as the Fsync phase meter. The decoded audio signal from the Rx1 is clocked into the DSP A on the digital unit. The protocol data that are simultaneously applied are also sent to the DSP, where they can be picked up for analysis by the controller of the UPL.

The DDS sync generator permits variable setting of the sampling frequency in the range from 27 kHz to 55 kHz for the internal digital generator Tx1 and the REF generator Tx2. The REF generator is always operated with the internally generated clock GEN CLK. The digital generator can also be synchronized with the audio input, the REF input or the sync input. The audio data for the Tx1 are provided by the DSP A on the digital unit. The output clock of the Tx1 can be jittered using a PLL. The jitter modulator signal required for this purpose is provided by the analog generator of the UPL.

The **reference PLL** on the AES main board serves various purposes. In the case of external synchronization, it is used to synchronize the generator with a signal applied to the SYNC input (e.g. Wordclock, Video). For phase generation, the reference PLL is used to generate the phase offset between the digital generator Tx1 and the REF generator Tx2. The reference PLL permits a high-stability VCXO to be cut in each for the sampling frequencies 32 kHz, 44.1 kHz and 48 kHz and a tunable VCO for variable sampling frequencies in the range from 27 kHz to 55 kHz. In the case of the jitter measurement, the reference PLL is used for generation of a low-jitter reference clock. This clock is also used for sampling the input signal for the reclocking function. The internally generated jitter-free clock of the generator can also be used as a reference for the jitter measurement. The demodulated jitter signal is applied to channel 2 of the analog analyzer, where the complete measurement analysis is performed.

The **phase measurement** is performed by phase comparison of the frame sync signals obtained from the decoders Rx1 and Rx2. The phase-proportional dc voltage is applied to channel 1 of the analog analyzer. For adjusting the phase meter via the software, a defined input signal is applied with 0° and 180°. The phase meter features a maximum measurement range of -360° to $+360^\circ$. However, only the range from -180° to $+180^\circ$ is displayed.

If the digital option UPL-B2 is installed, the following generator and measurement modes are provided:

- Audio data:

  The audio contents of the digital signal is generated by the generator and evaluated by the analyzer. Further processing is similar to the analog measurements. The interface amplitude of the digital output can be set. The protocol analysis function is only possible with the Option UPL-B21 installed.

- Jitter generation and measurement:

  In the generator, the digital audio signal is jitter-modulated , defined with the analog generator provided in the UPL. If the Low Distortion Generator (UPL-B1) is installed, jitter frequencies up to 110 kHz are possible. In the analyzer, the jitter contained in the digital audio signal is demodulated and applied to the analog input unit. There, the evaluation is performed as with the analog measurements. The signal is analyzed with the fast 110-kHz converter. Jitter generation and analysis are only possible with the Option UPL-B22 installed.

- Phase generation and phase measurement:

  In this case, a defined phase reference between digital generator and REF generator (rear of instrument) is set. The digital analyzer measures the phase offset of the AES signal between the digital input and the REF input (rear of instrument). The reference PLL is used for phase generation, which is why it is not available for the external generator synchronization or for the jitter measurement. Phase generation and phase measurement are only possible with the Option UPL-B22 installed.

- Common-mode signal generation and input measurement:

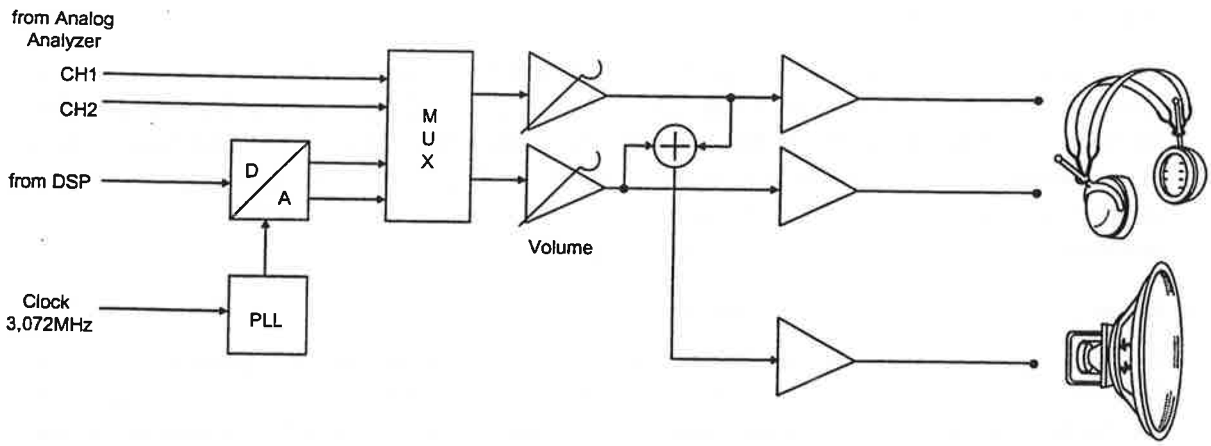
  Here, a common-mode signal is superimposed on the BAL interface of the UPL. A common-mode signal applied to the BAL input and the interface amplitude of the digital signal are measured with the analog analyzer. Either the common-mode frequency or the sampling frequency is displayed on the frequency display. Common-mode generation and analysis are only possible with installed Option UPL-B22.

4.8 UPL-B4, Remote Control

This option contains no hardware but merely consists of the software enabling of the IEC-bus controller. The software is enabled by entering a code number in the OPTIONS panel. The code number is to found on an adhesive label on the rear panel of the instrument.
For further information, refer to volume 2 of the service manual or to the help function.

4.9 UPL-B5, Digital Audio Monitor

(cf. UPL block diagram)



The Audio Monitor Option UPL-B5 permits visual control (using an oscilloscope at the headphone jack) or audio control (via the built-in speaker or externally connected headphones) of the signals processed by the UPL. Simple testing of an applied analog voltage, the digital audio signals converted to the analog range or the analog input voltage subsequently processed by the DSP may be involved (e.g. the influence of digital filtering of the original input signal).
The option contains various setting facilities for switching over the signal source, which extends to the analog and digital level and permits both mono and stereo replay of signals that have been fed in.

The voltage applied to the analog analyzer is matched in its level and taken to the audio monitor option, where it is applied to a multiplexer which performs switchover of the input. Other inputs of this input selector switch are controlled by the signals converted to the analog range by a 16-bit DAC.
These audio signals which, initially, were digitally encoded may have two different origins: Either they are the input signals of the Option UPL-B2 (digital I/O) or they are analog input signals which have been subject to digital processing in the UPL (e.g. digital filtering). The signal path to the audio monitor option is the same in both cases, i.e. the digital signals are provided directly by the DSP A (see also section 4.5.3, page 4.5.3). The DAC installed in the audio monitor option is clocked by a PLL circuit, the reference frequency of which is also provided by the DSP A and is synchronous with the digital audio signals. Thus, monitoring of digital input signals is possible in the extended clock frequency range from 27 to 55 kHz.
Following the multiplexer, the volume setting is performed, which has the same effect on both outputs (internal speaker and external headphones connector/ 6.3mm headphone jack). Whereas the headphones output also permits stereo operation, the voltages of the two channels for controlling the internal speaker are added and taken to a separate power amplifier.

It is possible to select between different reactions to commands for the speaker and headphones output (in the analyzer panel):

Phone Out = SPEAKER: All commands act on speaker and headphones in parallel. The internal speaker is switched off by connecting external headphones. The LOCAL key simultaneously switches on or off the internal speaker and headphones output.

Phone Out PERMANENT: The internal speaker remains switched on irrespective of the connection of the headphones socket, the LOCAL key only causes the internal speaker to be switched off, the headphones output remains active.

The output level of the audio monitor option can be varied in two ways:

Volume (0 ... 100%): The volume adjustment varies the bit combination for the level DACs on the option and thus the attenuation of the incoming signals. This function is possible with all input configurations.

Pre Gain (–120 ... +120dB): Variation of the output voltage per pre-gain is a purely arithmetical process and does not affect the hardware on the UPL-B5. This function is only offered with FNCT CH1/2/1&2 selected and (arithmetically) "amplifies" or "attenuates" the residual signal of a digitally processed analog input voltage of the 22-kHz analog analyzer.

4.10 UPL-B10, Universal Sequence Controller

Software option, see chapter 4.8.

4.11 UPL-B21, Digital Audio Protocol

Software option in addition to option UPL-B2, see chapter 4.8. Option UPL-B2 must be installed.

4.12 UPL-B22, Jitter and Interface Test

Software option in addition to option UPL-B2, see chapter 4.8. Option UPL-B2 must be installed.

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Chapter 5
Repair

5.1 Function Test and Troubleshooting

5.1.1 Quick Test

The settings and tests described in the following are used for fast checking of the general functioning of the instrument, dispensing with external measuring aids as far as possible. They cover only part of the analyzer and generator functions and are used for testing after installation of options or replacement of modules.
A complete function test requires the complete test report to be executed.

5.1.1.1 Selftest

Check the AC supply voltage at the outlet and check whether the UPL is set to this AC supply voltage. Then connect the UPL to the AC supply and switch on.
The backlighting of the display must be illuminated, the hard disk must start up and the BIOS is started. The BIOS performs a selftest consisting of the following tests:
- ▷ Memory test.
- ▷ Checking of the serial and parallel input and output.
- ▷ Checking of the floppy disk and hard disk.

Following these tests, the BIOS loads MS-DOS® [1] from the hard disk and executes the start files config.sys and autoexec.bat. These files contain the start of the UPL software which performs the following tests. This is indicated by means of `self test running`.
- ▷ Checking of the digital boards, reading of the board identification.
- ▷ Checking of the software version and checksum of the instrument setup.
- ▷ Checking of the shift registers for setting of analog modules.
- ▷ Starting of both DSPs: Checking whether the operating system in the DSP responds properly and loading of the application software into the two DSPs (see section 4.5.3, page 4.14).
- ▷ Checking the correction factors in the E^2PROM for plausibility.
- ▷ Monitoring of the dynamic range control of the analyzers and the overload control of the generator.

Then the user interface is started and the instrument is ready for use.
If the Audio Monitor (UPL-B5) is installed, a brief sound from the internal speaker can usually be heard on power-up.
In the event that the instrument does not reach this status, perform the appropriate tests according to section 5.1.3, page 5.8.

5.1.1.2 Short Test of Analog Interfaces

This short test permits fast checking of the analog interfaces of the UPL. No cables or measuring instruments are required. The analyzer measures the generator signal via the internal connection.

Before starting the short test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item

[1] MS-DOS is the registered trademark of Microsoft Corporation

LOAD INSTRUMENT STATE → Mode → DEF SETUP.

Set UPL:

Generator	
INSTRUMENT	ANALOG
Low Dist	OFF
FREQUENCY	991.00 Hz
VOLTAGE	3.0000 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 3.0 V RMS
INPUT DISP	RMS
FUNCTION	THD+N/SINAD

Check:

THD+N	min −105 dB, max −94 dB
Input RMS	min 2.950 V, max 3.050 V
FREQUENCY	min 990.90 Hz, max 991.10 Hz

- If the Option UPL-B1, Low Distortion Generator, is installed, set Low Dist ON in the generator panel.

  Check:

THD+N	min −115 dB, max −105 dB
Input RMS	min 2.950 V, max 3.050 V
FREQUENCY	min 986.00 Hz, max 996.00 Hz

- If the Option UPL-B5, Audio Output, is installed, set SPEAKER INPUT CH1&2 in the analyzer panel.

  Check: A whistling sound must be heard.

- If this test comes out positive, the following modules function properly:
  - DSP unit on the digital board,
  - Analog unit, i.e. analog generator and analyzer,
  - Low distortion generator (if installed),
  - Audio output (if installed),

  and the interfaces between these modules.

- If suitable cables are available, the connection via the terminals on the front panel should also be checked. To this end, select the respective input in the analyzer panel.

5.1.1.3 Short Test of Digital Interfaces

This short test permits fast checking of the digital interfaces of the UPL. No cables or measuring instruments are required. The analyzer measures the generator signal via the internal connection. If the Option UPL-B2, Digital Audio I/O, is not installed, this test cannot (and need not) be performed.

Before starting the short test, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
LOAD INSTRUMENT STATE → Mode → DEF SETUP.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Audio Bits	24
FREQUENCY	991.00 Hz
VOLTAGE	0.9000 FS

Analyzer	
INSTRUMENT	DIGITAL
Channel(s)	BOTH
Input	INTERN
Audio Bits	24
FUNCTION	THD+N/SINAD

Check:

THD+N	< −126 dB
Input RMS	min 0.8997 FS, max 0.9003
FREQUENCY	min 990.95 Hz, max.991.05 Hz

- If the Option UPL-B5, Audio Monitor, is installed:
  Set UPL: SPEAKER DIG CH1&2

  Check: A whistling sound must be heard.

- If this test comes out positive, the following modules function properly:
  - DSP unit on the digital board,
  - Digital audio I/O (incl. front panel and rear panel)
  - Audio monitor (if installed),

  and the interfaces between these modules.

- If suitable cables are available, the connection via the terminals on the front panel should also be checked. For this purpose, select the respective input in the analyzer panel.

- For checking the REF output, use an XLR cable to connect the REF output (rear panel) to the BAL input (front panel). If the REF output functions properly, the display
  - Input ? - Press Show I/O
  will disappear, and it will be displayed as input RMS 0.000 FS.

5.1.2 Troubleshooting

This section illustrates how to test errors that have occurred during the quick test of the UPL (not the data integrity). The same settings are used as for the quick test.

The following tests dispense with external measuring instruments as far as possible and assume that the instrument functions properly. In the event that the test cannot be carried out, proceed according to the respective notes and error messages.

If the instrument does not start up to reach the normal user interface, proceed according to the notes in the section Error Messages and States.

Before starting the troubleshooting, set the UPL to a defined initial status.
To this end, call the default setting in the FILE Panel under the menu item
LOAD INSTRUMENT STATE → Mode → DEF SETUP.

5.1.2.1 Basic Test Analyzer

Set UPL:

Analyzer	
INSTRUMENT	ANALOG
Channel(s)	2 ≡ 1

Do not connect the analog inputs (internal termination 600 Ω like default setup) and press key [CONT].

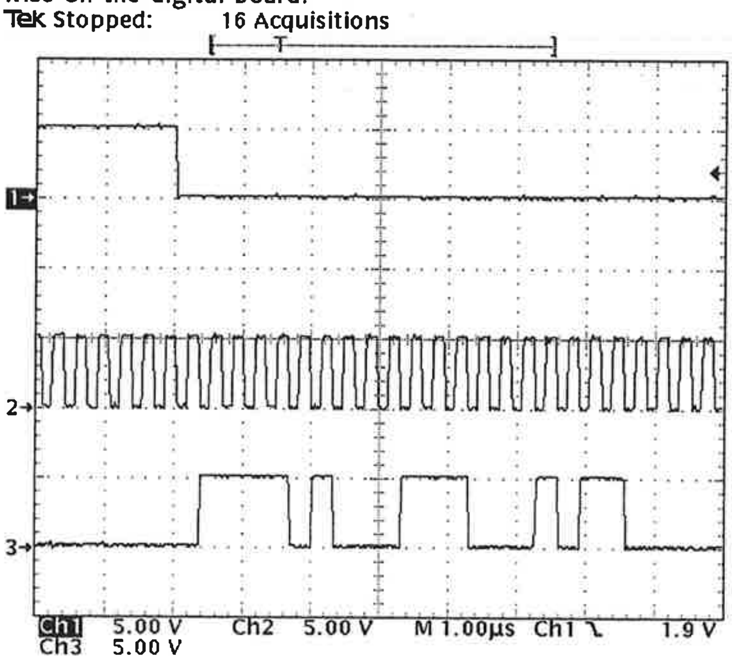
Check: $1\ \mu V < RMS < 2\ \mu V$

The status display on the top right of the screen must display the following after autoranging and DC offset adjustment:

```
GEN RUNNING
ANL 1:CONT 2:CONT
SWP OFF
```

▷ If the RMS value is too high or too small with this measurement, there is probably an error in the input section of the analog analyzer.

▷ If the RMS value is 0 with this measurement, the A/D converter or the digital board is probably faulty. To find out the true error source, check the lines ALR (W2 pin 2, trace 1), ASCLK (W2 pin 4, trace 2) and ASDATA (W2 pin 6, trace 3) (see fig.) on the interface from the digital board to the analog unit. If the ASCLK, ALR and ASDATA signals are missing, the error lies on the analog unit, otherwise on the digital board.



▷ If the status display of a GEN or ANL field signals ORUN, one of the DSPs is faulty. Check jumper X9 on the digital board.

▷ If the status display of an ANL field signals OVER, the dynamic range control on the analog unit is presumably faulty, or there is an impermissible use of the dynamic range due to a faulty signal path.

5.1.2.2 Analog Loop Measurement

Set UPL:

Generator	
INSTRUMENT	ANALOG
Low Dist	OFF
FREQUENCY	991.00 Hz
VOLTAGE	3.0000 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 3.0 V RMS
INPUT DISP	RMS
FUNCTION	THD+N/SINAD

Check:

THD+N	min –105 dB, max –94 dB
Input RMS	min 2.950 V, max 3.050 V
FREQUENCY	min 990.90 Hz, max 991.10 Hz

If, in this test,

▷ the THD+N value is unacceptable:
- If the Option UPL-B2 (Digital Audio I/O) is installed, repeat the measurement at the digital interface. If a poor THD+N value is obtained again, the error lies on the digital board (presumably interruption on a DSP bus).
- If installed, switch on the Option UPL-B1 (Low Distortion Generator).
  If a poor THD+N value is obtained again, the error presumably lies in the analyzer section of the analog unit.
  If the THD value is okay now, the following errors may be involved:
  - D/A converter on the analog unit is faulty.
  - Leads to the D/A converter are interrupted. Check the control signals according to the list below (see faulty level display).
  - DSP error on the digital board.
- If the THD+N value is poor for the analyzer channel only, only this one is faulty; the generator is presumably okay.
- If THD+N of both channels is poor, use an external audio analyzer for checking and determining whether the generator or the analyzer is faulty.

▷ the THD+N value is better than expected: Switch on the post-FFT and check the spectrum; there should be a uniform noise floor. To be on the safe side, the THD+N measurement can be repeated with other frequency points.

▷ the level display is not correct:
- Select another measurement range and observe the display of the other analyzer channel. If the same (wrong) level is displayed again, the output level setting of the generator is probably faulty. If the level is correct, the error probably lies in the input section of the analyzer.
- Select another generator level (0.1 V). A relay on the generator must switch over, producing a (slightly) audible sound. If the displayed level is correct now, the error lies on the analog unit. If the displayed level is wrong again, check the level using an external audio analyzer or AC voltmeter or oscilloscope and determine whether the generator or the analyzer is faulty.
  - If the output level of the generator is missing, check the control of the D/A converter and the setting shift register.
    The control of the D/A converter consists of the lines Clock (GBCLK W1, Pin 2), Data (GDATA W1, Pin 7) and Framesync (GLR (W1, Pin 4).
    If the GBCLK is missing, the error lies on the analog unit, if the GBCLK is provided but the GLR or the GDATA is missing, the error lies on the digital board.

The setting shift register can be checked according to the description in section 4.4, page 4.10.

- If the output level of the generator is okay, however the analyzer does not measure correctly, the error presumably lies in the input section of the analyzer.

▷ the frequency display is not correct:

- Check the frequency using an external frequency counter and determine whether the generator or the analyzer is faulty.

5.1.2.3 Analog Loop Measurement using the Low Distortion Generator

If the Option Low Distortion Generator is installed:

Set UPL:

Generator	
INSTRUMENT	ANALOG
Low Dist	ON
FREQUENCY	991.00 Hz
VOLTAGE	3.0000 V

Analyzer	
INSTRUMENT	ANLG 22kHz
Channel(s)	2 ≡ 1
Input	GEN CROSSED
Range	FIX: 3.0 V RMS
INPUT DISP	RMS
FUNCTION	THD

Check:

THD+N	min −115 dB, max −105 dB
Input RMS	min 2.950 V, max 3.050 V
FREQUENCY	min 0.9860 kHz, max 0.9960 kHz

Set UPL:

Analyzer	
INSTRUMENT	ANLG 22kHz
FUNCTION	THD

Check: THD $<$ −110 dB

If the THD+N value is unacceptable in this test, however if it is okay with the normal loop measurement, the Option UPL-B1 (Low Distortion Generator) is faulty.

5.1.2.4 Digital Loop Measurement, Audio Data

This test can only be performed if the Option Digital Audio I/O (UPL-B2) is installed:

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Audio Bits	24
FREQUENCY	991.00 Hz
VOLTAGE	0.9000 FS

Analyzer	
INSTRUMENT	DIGITAL
Channel(s)	BOTH
Input	INTERN
Audio Bits	24
FUNCTION	THD+N/SINAD

Check: THD+N $<$ −126 dB

If, in this test,

▷ there is no defined display (THD+N):

- Repeat the measurement on the digital interfaces of the front panel. If the display is undefined again, the error lies either in the connection between front panel and AES mainboard or on the digital board (DSP area, connection to Option UPL-B2). If the Digital Audio I/O module functions properly, the sample frequency of the applied digital audio signal can be output at the SYN output and measured (AUDIO IN applied to SYNC OUT). If no signal reaches the digital audio receivers, the frequency of the Sync output only lies at about 10 kHz.
- If the display is only faulty with the audio interfaces BAL or UNBAL selected, there is probably an error on the front panel module of the digital I/O module. If the Option UPD-B21 is installed, the input pulse amplitude can be checked at the BAL or UNBAL input.
  - Output amplifiers may be faulty.
  - Input amplifiers may be faulty.
  - Input comparator unit is not okay.

5.1.2.5 Digital Loop Measurement, Phase

This test can only be performed if the Options UPL-B2 and UPL-B22 are installed.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	PHASE
PhaseToRef	25 %FRM
Sample Frq	27...55kHz
REF Out	REF GEN

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	Jitter/PHAS
Input	INTERN
Jitter Ref	GEN CLK
INPUT/PHAS	PHAS TO REF
FREQ/PHASE	SAMPLE FREQ

Use XLR cable to connect the REF input to the REF output on the rear panel of the UPL.

Check:	Phase DIG IN to REF	min 23 %FRM , max 27 %FRM
	Sample FREQUENCY	display according to sample frequency set on the generator

If, in this test,

▷ there is no defined display of the phase (DIG IN to REF):

- Repeat the measurement at various sample frequencies on the generator (32 kHz, 44.1 kHz, 48 kHz, Value).
  If the display is undefined again, first perform the audio data test as described above in order to check the front panel module. If this test is okay, there is an error either on the rear panel module or in the connection between rear panel module and AES mainboard.
  If the phase measurement or the sample rate measurement is only faulty at certain sample frequencies, an error on the AES mainboard (reference PLL) is involved.
- If the phase display is wrong, however corresponds to the setting on the generator, the software adjustment is faulty, or there is an error on the AES mainboard (phase setting, reference PLL).
  In this case, perform an adjustment first (OPTIONS Panel, call CALIBRATION DIG ONCE) and check the phase measurement again.

5.1.2.6 Digital Loop Measurement, Jitter

This test can only be performed if the Options UPL-B2 and UPL-B22 are installed.

Set UPL:

Generator	
INSTRUMENT	DIGITAL
Src Mode	Jitter
Sync To	GEN CLK
Sample Frq	48 kHz
FUNCTION	SINE
Jitt Freq	10 kHz
JittPkAmpl	0.5 UI

Analyzer	
INSTRUMENT	DIGITAL
Meas Mode	Jitter/PHAS
Input	INTERN
Jitter Ref	GEN CLK
FREQ/PHASE	FREQ
INPUT/PHAS	PEAK
FUNCTION	RMS & S/N
Filter	OFF

Check:

Jitter Input Peak	min 0.4 UI, max 0.6 UI
Jitter FREQUENCY	min. 9.99 kHz, max. 10.01 kHz

If, in this test,

▷ the display of the jitter amplitude is wrong:
  - Repeat the measurement with different jitter references and sample frequencies. For checking the jitter signal, the FUNCTION WAVEFORM can be selected. This permits to observe very easily whether the individual PLLs lock in for the jitter reference. If the jitter measurement is only wrong with the respective PLL for the individual sampling rate, the error lies in the reference PLL. In this case, check the phase measurement at different sample frequencies as described above.
  - If the display is wrong even with GEN CLK as jitter reference, there is an error in the jitter demodulator on the AES mainboard.

5.1.3 Error Messages and States

Preliminary remark:
In the case of instrument versions with monochrome LCD, error messages produced when the instrument is started (i.e. by the BIOS or from the two control files `autoexec.bat` and `config.sys`), can only be viewed on the external monitor, since the contrast voltage of the LCD is only set on starting of the UPL software.

- The display of the monochrome instrument remains dark.

  In this case, an external monitor should be connected in order to determine the error cause:

  1. The instrument starts up normally, the internal display is not deactivated in the OPTIONS panel.
     ▷ Contrast voltage may be misadjusted.
     A misadjusted contrast voltage can be restored by selecting the contrast key and setting the correct contrast voltage. This setting is permanently stored in an E^2PROM on the analog unit.
     ▷ Hardware error in the contrast voltage generation (on the digital board);
     ▷ +12V supply from the power supply is missing, in this case, the fan rotates very slowly.

     If the contrast voltage is not correct after switching the instrument off and on again, either the E^2PROM or the control is faulty.

The display itself may also be faulty or not correctly connected.

Check the jumpers in the middle of the digital board (X27) for correct setting of the display type (see labelling on the board).

2. The instrument starts up, however, *gets stuck* on execution of the start files: evaluate the respective error message (see below).
3. The instrument does not start:

   Fan and hard disk function properly?

   ▷ Fan and hard disk do not work.
   Check AC supply voltage and power fuses.
   Check the voltages of the power supply unit (see section 5.2.13, page 5.22).

   ▷ Fan and hard disk work.
   The hard disk starts up, however there is no picture neither on the external nor on the internal monitor:
   - Reset generation faulty or cable not connected. Check pin 10 of the current supply plug on the built-in PC.
   - VGA error: in this case, 8 successive whistling sounds can be heard after switching on.
   - RAM faulty or not plugged in.
   - PC mainboard and digital board are not correctly connected: Remove AT-bus adapter, clean using a rubber eraser and replace; make sure not to touch the contacts with your fingers.

   ▷ Fan works, hard disk does not work (no operating noise to be heard).
   Check connection from digital board to hard disk.
   Check voltages (esp. 5V) of the power supply unit (see section 5.2.13, page 5.22, fuse F9).

   ▷ Fan does not work, hard disk works.
   If the +12V is okay and the fan is connected (on the digital board), the fan is probably faulty.

- Error message: HDD controller failure

  Possible error causes:

  ▷ Setting in the BIOS faulty (The hard disk is set using `autodetect hard disk`, see also section 5.2.10, page 5.19 and in the Operating Manual).

  ▷ Cable connection from hard disk to digital board is incorrectly inserted; this line is not coded, therefore note the correct pin assignment.

  ▷ Hard disk does not work, in this case, there is no operating noise.

  ▷ Hard disk has a disk error, in this case, it is to be replaced (see section 5.2.10, page 5.19). The hard disk must not be reformatted (low level).

- Error message: FDD failure

  Possible error causes:

  ▷ Setting in the BIOS faulty, floppy drive has a capacity of 1.4 MByte.

  ▷ Cable connection from floppy drive to digital board is not correctly inserted; This line is not coded, therefore note the correct pin assignment, pin 1 of the plug cannot be pin 1 of the line. The line is correct (and decisive)!

- Error message: Can't boot DSPs

  Possible error causes:

  - ▷ The DSPs are not provided with a clock; check jumper X9 next to the 60-MHz crystal.
  - ▷ The interface to the DSPs is faulty.
  - ▷ Memory on the DSP is faulty.

- The LED GEN OVLD (Generator Overload) is illuminated on startup of the instrument.
  - ▷ Overload or short-cicuit at the generator output.
  - ▷ Check the voltage supply of the output stage: Check the ±20 V in the power supply unit (see section 5.2.13, page 5.22). If these voltages are missing, check the soldered-in pot fuses F4 and F5 in the power supply and replace, if necessary.

- Audio monitor does not function.

  Since the audio monitor is controlled in two different ways, both the short test of the analog interfaces and the short test of the digital interfaces should be performed.

  Further troubleshooting hints if the short test of the analog interfaces was faulty:
  - ▷ `VOLUME` set to 30 %?
  - ▷ Analyzer measures generator input signal?
  - ▷ Connect external headphones and check whether a tone can be heard.
  - ▷ Are all cables connected to the UPL-B5 (W10 to Digital Board, X20 to headphones output, X30 to internal speaker)?
  - ▷ Check supply voltages (W10 pins 6, 17, 18 and 20)
  - ▷ Input signals applied to W10 pins 23 and 25?

  If only the short test of the digital interfaces is faulty, perform the following tests:
  - ▷ Clock for the DAC (3.072 MHz) provided (`ICLOCK`, W10 Pin 2)?
  - ▷ Frame-Sync signals (`B5LR`, W10 Pin 4), and digital audio data (`B5DATA`, W10 Pin 7) provided? If these signals are missing, however the analyzer functions properly otherwise, the digital board or connecting cable W10 is probably faulty.

  If these tests do not permit to determine the error, the audio monitor is probably faulty and must be replaced.

5.2 Module Replacement, Adjustment and Testing

All modules of the UPL and the connecting cables between the modules are represented in the circuit diagram of the UPL 1078.2008.01S, see Volume 2, Register 1.

5.2.1 General

5.2.1.1 Required Tools

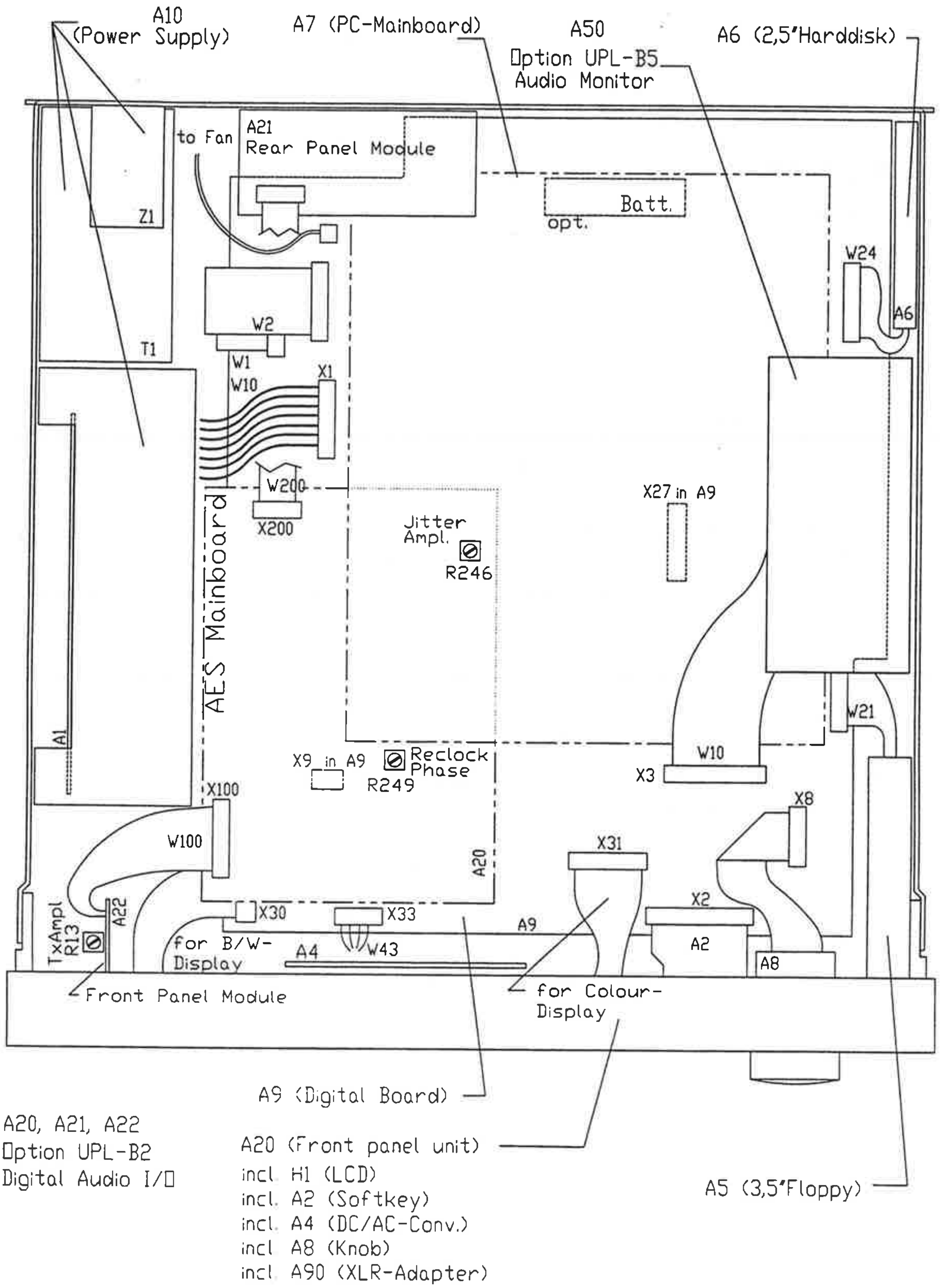
- ▷ Phillips screwdriver, size 0
- ▷ Phillips screwdriver, size 1
- ▷ Phillips screwdriver, size 2
- ▷ Screwdriver, size 2 or 3
- ▷ Screwdriver, size 4
- ▷ Wrench, size 10

5.2.1.2 Opening and Closing the Instrument

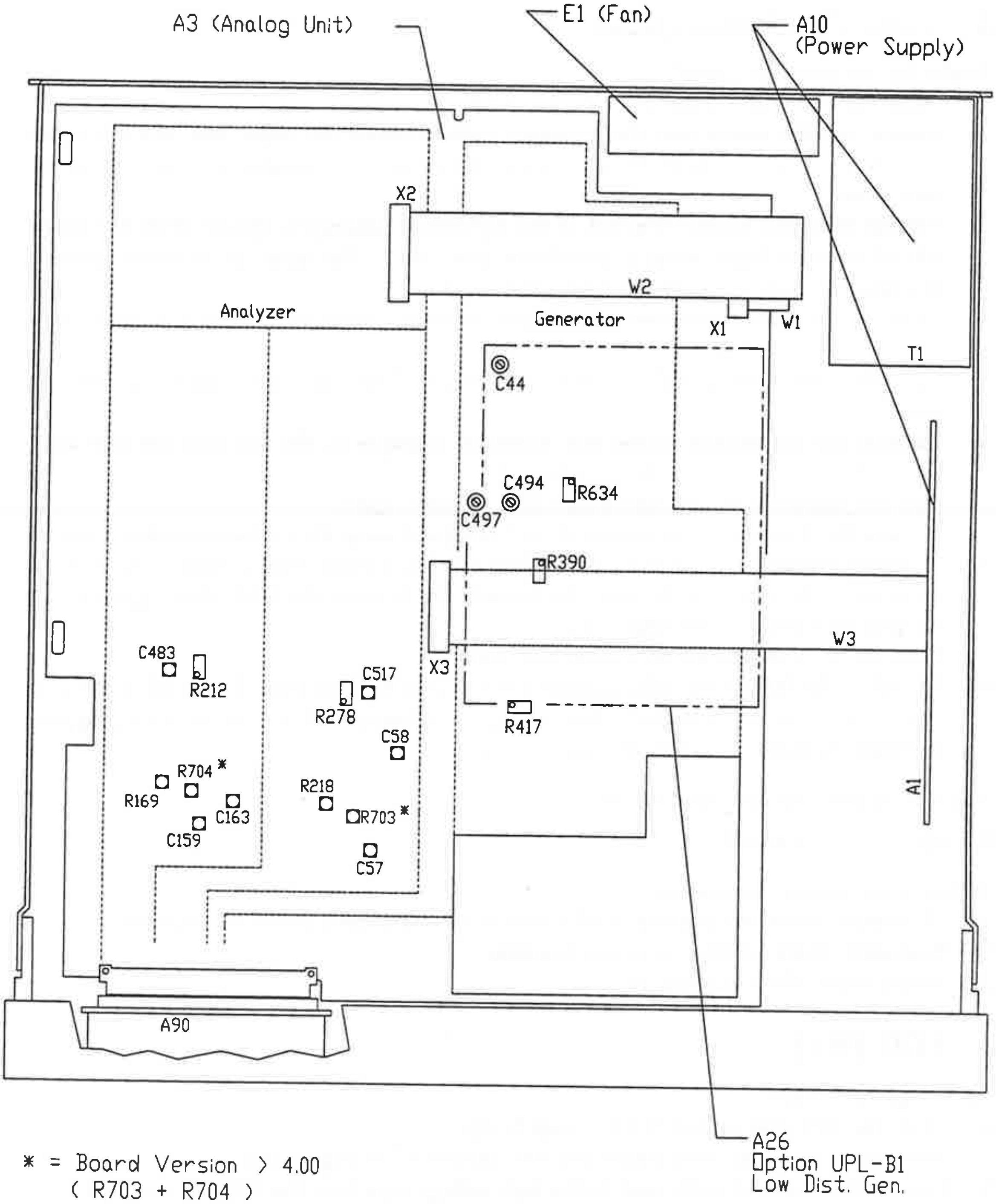
- ▷ Switch off UPL (set power switch to the **OFF** position).
- ▷ Disconnect power cable.
- ▷ Unscrew rear-panel feet (4 screws at the corners of the instrument, Phillips screwdriver, size 2).
- ▷ Slide the upper instrument cover slightly towards the rear and lift off.
- ▷ Place the instrument upside down, slightly push the lower instrument cover towards the rear and remove.
- ▷ When closing the instrument make sure that the RF seal cord properly fits into the groove.
- ▷ Mount the instrument covers in the reverse order, making sure that the covers engage properly in the respective grooves.
- ▷ Fasten the rear-panel feet using the screws and tighten the screws.

The following description of module replacement assumes that the UPL is brought to its normal operating position again after opening the instrument.

5.2.1.3 Views



UPL, Top View



UPL, Bottom View

5.2.2 Front Panel Unit (A20)

- Replacing the complete module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Loosen the flat cables and the 4-contact cable between the front unit and the other printed circuit boards inside the instrument. All cables are accessible from the top of the instrument.
  - ▷ Lift the blue-grey plastic strip out of the righthand, rectangular groove from the upper side of the front frame using a screwdriver, size 2 or 3. This strip can be easily removed and properly inserted again at a later point in time.
  - ▷ Unscrew the countersunk screw that is now accessible using the Phillips screwdriver size 1.
  - ▷ Turn the instrument by 180° so that the bottom of the instrument points towards the top.
  - ▷ Unscrew the countersunk screw that is located opposite to the one that has just been removed (top / bottom, in the front frame).
  - ▷ Turn the instrument to its normal operating position again.
  - ▷ Remove the 4 screws at the corners of the front panel using the phillips screwdriver size 1.
  - ▷ Straightly withdraw the front panel unit from the front frame, with a slight pressure from the inside. The best place to exert the pressure lies between the LCD retaining plate and the grey-blue body of the rotary knob.
  - ▷ Place the front panel unit on a clean, soft surface.
  - ▷ To replace the front panel unit, proceed in the reverse order to that of removal; make sure that the keyboard is connected before sliding in the front panel unit, because the plug will no longer be easily accessible afterwards.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement
  - ▷ LC display: check the contrast (in the case of monochrome), colors, backlighting.
  - ▷ Keyboard: check all keys for proper response.
  - ▷ Rotary knob: check the function.

5.2.3 LCD (H1)

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Remove the complete front panel unit (see section 5.2.2, page 5.14).
  - ▷ Loosen the 4-contact cable next to the high-voltage sign from the DC/AC converter.
  - ▷ Loosen the 6 raised fillister head screws of the LCD retaining plate using Phillips screwdriver size 1 and take off the retaining plate. Carefully withdraw the two cables through the cutouts.
  - ▷ The LCD is already loose and can be removed.

  Hints for assembly in the reverse order:
  - ▷ Clean the viewing area of the LCD if necessary.
  - ▷ Fasten self-adhesive dust shields (65cm long, order no. 0852.1805.00) around the viewing area.
  - ▷ Turn the LCD upside down and place it on the 4 threaded studs of the mounting plate.

▷ Place the LCD retaining plate on top of it and feed the connecting cables through the cutouts in the plate.
▷ CAUTION: Make sure not to squeeze the cables between the retaining clips of the LCD and the spacers in the retaining plate.

- Adjustment after module replacement.

  No adjustment is required.

- Testing after module replacement

  As with replacement of front panel unit:
  ▷ LC display: check the contrast (in the case of monochrome), colors, backlighting.
  ▷ Keyboard: check all keys for proper response.
  ▷ Rotary knob: check the function.

5.2.4 XLR Adapter (A90)

- Replacing the module
  ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  ▷ Remove the complete front panel unit (see section 5.2.2, page 5.14).
  ▷ Place the front panel unit onto its rear side.
  ▷ Remove the rotary knob from the front panel.
  ▷ Remove the 5 small, light-grey countersunk screws in the labelled front panel using Phillips screwdriver size 0 and take off the front panel.
  ▷ Remove the 10 countersunk screws in the immediate vicinity of the XLR connectors using the Phillips screwdriver size 1.
  ▷ To replace the module, proceed in the reverse order to that of removal.

- Adjustment after module replacement

  Check the output balance of the generator, see section 2.2.1.13, page 2.21. Instead of UPD the UPL analyzer can be used as measuring instrument in this case.

  If the test values are out of tolerance, the output balance must be readjusted, see section 3.2.1.5, page 3.5.

  Check the common-mode rejection of the analyzer, see section 2.2.2.6, page 2.27. Instead of UPD the UPL generator can be used as signal source in this case.

  If the test values are out of tolerance, the common-mode rejection must be readjusted, see section 3.2.2.2, page 3.7.

- Testing after module replacement

  Function tests as with replacing the front panel unit.

5.2.5 Rotary Knob (A8)

- Replacing the module
  ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  ▷ The front panel unit does not have to be removed.
  ▷ Withdraw the rotary knob from the front panel.
  ▷ Remove the 5 small, light-grey countersunk screws in the labelled front panel using the Phillips screwdriver size 0 and take off the front panel.

- ▷ Remove the 2 countersunk screws next to the rotating shaft of the rotary knob using the Phillips screwdriver size 1.
- ▷ When reassembling the rotary knob make sure that the flat cable connector of the rotary knob points to the top.
- ▷ To reassemble the rotary knob, proceed in the reverse order to that of removal.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  Check the rotary knob for proper functioning.

5.2.6 Softkey (A2), Glass Pane

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Remove the complete front panel unit (see section 5.2.2, page 5.14).
  - ▷ Remove XLR adapter (see section 5.2.4, page 5.15).
  - ▷ Remove LCD (see section 5.2.3, page 5.14).
  - ▷ Remove the 5 countersunk screws and 1 raised fillister head screw from the keyboard retaining plate using the Phillips screwdriver size 1.
  - ▷ The keyboard and the glass pane are now loose.

  Hints for reassembling the module in the reverse order to that of removal:
  - ▷ Separate the rubber mat of the keyboard at the lip intended for this purpose.
  - ▷ All parts must be free from dust and dirt (do not clean wet the keyboard foil).
  - ▷ When inserting the keyboard parts in the mounting plate make sure that they firmly fit into the provided cutouts.
  - ▷ The conducting layer of the glass pane must point towards the inside of the instrument. This side can be recognized by the surrounding silver frame.
  - ▷ The contact springs of the glass pane retain the glass pane and ensure its electrical contact in the mounting plate. The narrow ribs of the springs point towards the outside of the instrument.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  As with replacement of the front panel unit
  - ▷ LC display: check the contrast (in the case of monochrome), colors, backlighting
  - ▷ Keyboard: check the keys for proper response
  - ▷ Rotary knob: check the function.

5.2.7 DC/AC Converter (A4)

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ The front panel unit need not be removed.
  - ▷ Loosen the two cable connectors from the DC/AC converter.

▷ Unscrew the perforated sheet cover and the DC/AC converter (Phillips screwdriver, size 1).

▷ When installing the DC/AC converter make sure that the pcb is mounted such that the insulating washers are inserted between threaded studs and pcb as well as between pcb and screws.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  Check the LCD backlighting

5.2.8 Analog Unit (A3)

- Replacing the module

  ▷ Open the UPL (see section 5.2.1.2, page 5.11).

  ▷ Place the instrument upside down so that the bottom of the instrument points towards the top.

  ▷ If installed, the low distortion generator must be removed first (see section 5.2.14, page 5.22).

  ▷ Disconnect the 3 flat cables W1, W2 and W3 on the analog unit.

  ▷ The analog unit is attached to the intermediate sheet by 3 screws; loosen these screws using the Phillips screwdriver size 1.

  ▷ Press the white plastic supports towards the outside and slightly lift the module.

  ▷ Slide the module towards the rear in order to open the connection to the XLR adapter and take it out towards the top.

  ▷ For replacing the module, proceed in the reverse order to that of removal.

- Adjustment after module replacement

  NOTE

  The module is tested and adjusted in the factory. The correction factors for analog analyzer and analog generator determined in the adjustment are stored in the E^2PROM on the module.

  Check the output balance of the generator, see section 2.2.1.13, page 2.21. Instead of UPD the UPL analyzer can be used as measuring instrument in this case.

  If the test values are out of tolerance, the output balance must be readjusted, see section 3.2.1.5, page 3.5.

  Check the common-mode rejection of the analyzer, see section 2.2.2.6, page 2.27. Instead of UPD the UPL generator can be used as signal source in this case.

  If the test values are out of tolerance, the common-mode rejection must be readjusted, see section 3.2.2.2, page 3.7.

  If the Option UPL-B1 (Low Distortion Generator) is installed, call the automatic adjustment routine, see section 3.3.2.2, page 3.16.

  If the Options UPL-B2 (Digital Audio I/O) and UPL-B22 (Jitter and Interface Test) are installed, call the automatic adjustment routine, see section 3.3.5, page 3.24.

In the case of instruments with monochrome LCD, call the contrast voltage setting once (see Operating Manual). This causes the current contrast value to be stored in the E^2PROM again.

- Testing after module replacement

  NOTE:
  Just to determine whether the module works or not, it is sufficient to perform the "short test of analog interfaces" as described in section 5.1.1.2 on page 5.1.

Short performance test for analog generator:
The measurements are described in section 2.2.1 Performance Test Analog Generator, starting at page 2.11.

▷ Level accuracy with 1 V, 1 kHz, Output Unbal, channel 1.
▷ Frequency response with 2 V, Output Unbal, channel 1.
▷ THD+N with 2.5 V, 2 kHz, Output Unbal, channel 1.
▷ If the Option Low Distortion Generator is installed:
  - Level accuracy with 1 V, 1 kHz, Output Unbal, channel 1.
  - Frequency response with 2 V, Output Unbal, channel 1.
  - THD and THD+N with 2.5 V, 1 kHz, Output Unbal, channel 1.

  The measurements are described in section 2.2.3 Performance Test UPL-B1, starting at page 2.42.

Short performance test for analog analyzer (with the instruments ANLG 22kHz and ANLG 110kHz and both channels):

▷ Level accuracy with 3 V RMS
▷ Frequency response in the level range 3 V
▷ THD+N with 3 V, 1 kHz

5.2.9 Digital Board (A9)

- Replacing the module
  ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  ▷ Remove the options UPL-B2 (Digital Audio I/O, modules A20 and A21) and UPL-B5 (Audio Monitor, module A50) if installed.
  UPL-B2: see section 5.2.15, page 5.23.
  UPL-B5: see section 5.2.16, page 5.24.
  ▷ Remove PC Mainboard (processor, module A7) (see section 5.2.11, page 5.20). Mark the position of the insulating washers, if provided, for later installation.
  ▷ Disconnect the cables to the analog unit on the analog unit and pull up. These cables are accessible from the bottom of the instrument.
  ▷ Loosen all screws of the digital board and the 3 screws of the sheet support at the rear of the instrument (Phillips screwdriver size 1).
  ▷ Unplug all other cables.
  ▷ The digital board can then be swivelled out towards the front and top.
  ▷ When replacing the digital board in the reverse order make sure to connect the flat cable of the keyboard to socket X2 first, because the plug will no longer be easily accessible later.

- Adjustment after module replacement.

  The module requires no adjustment.

Plug in jumpers X27 for monochrome or colored display at the correct location, see labelling on the board.

If the UPL is equipped with a monochrome LCD, the contrast voltage must be readjusted after module replacement. To this end, the contrast voltage adjustment must be called up once (see Operating Manual). The new contrast value is automatically stored in the E^2PROM on the analog unit.

The instrument setup is stored as a backup copy on the hard disk and, when starting the module for the first time after replacement, automatically restored in the CMOS-RAM on the new module.

- Testing after module replacement

  The module does not influence technical data. In order to make sure that there are no faults, perform the following tests.

  ▷ General function test of the analog generator and analyzer, see page 5.1.

  ▷ Testing the signal-to-noise ratio of the analog generator and analyzer. To this end, measure THD+N with 2.5 V, 2 kHz, Output Unbal, channel 1, this measurement is described in section 2.2.1 Performance Test Analog Generator, starting at page 2.11.

  ▷ Function test of the Audio Monitor option (if installed), see page 5.1.

  ▷ Function test of the Digital Audio option (if installed), see page 5.23.

  ▷ Function test of the front panel unit, see page 5.14.

  ▷ Function test of the floppy disk drive, see page 5.21.

5.2.10 Hard Disk (A6)

- Replacing the module

  ▷ If it is still possible, a backup copy of the hard disk should be made.

  ▷ Open the UPL (see section 5.2.1.2, page 5.11), only remove the upper instrument cover.

  ▷ Withdraw the 44-contact cable from the drive (at the rear right at the side panel).

  ▷ Loosen the screws (Phillips screwdriver, size 1) of the drive and take out the drive towards the top.

Reassembly:

▷ Connect the 44-contact data cable to the hard disk, then mount the hard disk at the chassis frame. The cable is not coded, observe the labelling on the hard disk and on the board.

▷ Check BIOS parameters, determine the drive parameters in the BIOS by means of *Autodetect Harddisk*.
(Note: in the case of the German keyboard, the **Y** *is provided by the* **Z***-key).*

▷ Reinstallation of DOS and UPL
After installing a new hard disk, DOS and UPL have to be reinstalled:

  - Install MS-DOS® [2] (in the directory C:\DOS).
    To this end, insert setup disk 1 and switch on the instrument. In the event that the UPL does not boot from the floppy disk, the start frequency may be set to `C: A:` in the BIOS. If this is the case, change it to `A: C:` for the installation. (See also DOS manual).

[2] MS-DOS is the registered trademark of Microsoft Corporation

- Install UPL: to this end, insert the disk UPL PROGRAM, change to A: and call UPLINST.
- The installed software options and the associated enabling codes are stored in the instrument and are maintained even after replacement of the hard disk. However, the analog unit must not be replaced together with the hard disk.

▷ CAUTION:
The hard disk contains correction data for the analog hardware and the instrument setup as backup copy. The instrument setup is again provided in the internal CMOS-RAM on the digital board. The correction data are again provided in the E^2PROM on the analog unit. If data are missing on the hard disk, they will automatically be restored with the contents of the CMOS RAM or the E^2PROM when the UPL is started.
In the event that the correction data stored in the E^2PROM do not comply with those on the hard disk, the values are transferred from the E^2PROM to the hard disk.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  Function test of the instrument and the hard disk.

5.2.11 PC Mainboard (A7)

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11), however, only remove the upper instrument cover.
  - ▷ If the Option UPL-B2 (Digital Audio I/O) is installed, remove the rear part of this option (AES Rear Panel), see section 5.2.15, page 5.23.
  - ▷ Loosen the screws of the PC mainboard (Phillips screwdriver, size 1)
  - ▷ Unplug the cable to X11 (=Power Good, if provided) and to X15 (speaker) on the digital board.
  - ▷ Then the PC mainboard can be lifted and the keyboard cable disconnected at the PC mainboard.

  Hints for assembly in the reverse order:

  - ▷ Check whether the SIM modules are properly mounted.
  - ▷ First insert the keyboard cable, then plug the PC mainboard onto the AT-bus adapter by exerting uniform pressure (the contacts of the adapter should not be touched).
  - ▷ Connect the lines for Power Good and speaker on the digital board.
  - ▷ Completely check the BIOS parameters.
    The *OPTIMAL* setting offered by the BIOS is used, and the AT-bus clock is subsequently set to a value smaller than 7.2 MHz. The drive parameters of the hard disk are determined by means of *Autodetect Harddisk*.
    NOTE: If the German keyboard is used, the **Y** is provided by the **Z**-key).

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  Switch on the instrument and check the function.

5.2.12 Floppy Disk Drive (A5)

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect the 34-contact data cable from the drive.
  - ▷ Disconnect the current-supply cable on the digital board.
  - ▷ If the audio monitor is installed, remove the headphone jack at the instrument front. It is fastened by means of a screw at the bottom side of the front frame at the extreme right (see also section 5.2.16, page 5.24).
  - ▷ Loosen the 3 screws of the drive (two screws from the bottom in the intermediate sheet, one screw from outside in the frame) using Phillips screwdriver size 1 and take out the drive towards the front.
  - ▷ For replacing the drive, proceed in the reverse order to that of removal.
  - ▷ Check the setting of the BIOS (1.44 MB).

    NOTE: Pin 1 of the mounted cable plug is <u>not</u> identical with pin 1 of the cable or of the plug at the floppy. The plug is thus inserted in the *opposite* way. The correct number is on the cable, note the labelling on the digital board.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  Switch on instrument and check proper functioning of the drive.

5.2.13 Power Supply (A10)

- Replacing the module

  <u>Tools</u>
  Phillips screwdriver, size 1
  Screwdriver, size 4
  Wrench, size 10

  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect cable W10 from the power supply or the digital board.
  - ▷ Place the instrument upside down so that the bottom points towards the top.
  - ▷ Disconnect cable W3 from the analog unit. If installed, the low distortion generator must be removed first (see section 5.2.14, page 5.22).
  - ▷ Lift off the switch rods of the power switch. To this end, laterally withdraw the sheet-metal rod from the rubber sleeve and take out towards the rear.
  - ▷ Disconnect the green-yellow grounding cable from the flat connector at the side panel.
  - ▷ Remove the 2 screws at the rear of the instrument and loosen the 3 screws at the left side of the instrument (Phillips screwdriver, size 1).
  - ▷ Place the instrument onto its right side.
  - ▷ Slide the power supply unit towards the front in order to disengage the lugs from the slots. Then take the module out of the instrument frame sideways (towards the top of the instrument).

    CAUTION: Be aware of the heavy weight of the module!

    NOTE: Sliding towards the front may be difficult. Therefore, it is recommended to use a screwdriver size 4, place it between transformer and chassis frame (from the bottom of the instrument) and lever the module out of the lateral slots, sliding it towards the front.

▷ Thus, the complete (functional) power supply unit has been removed from the UPL.

▷ Separate the printed circuit board from the heat sink after removing 4 screws in the heat sink and disconnecting the transformer connectors X10 and X11.
CAUTION: During operation under nominal load, the series regulators will then no longer be sufficiently cooled by the metal block to which they are screwed with an insulation!

▷ Take the transformer out of the mounting bracket by removing the hex screw using a wrench, size 10.

▷ For replacement, proceed in the reverse order to that of removal.

▷ Finally, reengage the switch rods for the power switch.

CAUTION:
Do not forget the ground connection at the chassis frame of the UPL!
Do not expose the switch to unnecessarily high mechanical stress!

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  After replacing the power supply unit it is recommended to check the available voltages.
  NOTE: If the UPL analyzer functions properly, it can be used as measuring instrument.

Test point	Nominal voltage	Connected modules
X1.2	+5V	Digital Board, digital circuits on the UPL-B5
X1.6	+15V	Analog circuits in the analog analyzer, UPL-B2 and B5
X1.8	–15V	Analog circuits in the analog analyzer, in UPL-B2 and B5
X1.10	+12V	Fan, LCD illumination, Output stage on the UPL-B5
W3.25–27	+5V	Digital circuits on the analog analyzer
These operating voltages are referred to ground GND.		
W3.1+2	+20V	Output stage of analog generator
W3.3+4	–20V	Output stage of analog generator and UPL-B1 (for the FET switches)
W3.7+8	+15V	Analog circuits in the analog generator and in UPL-B1
W3.5+6	–15V	Analog circuits in the analog generator and in UPL-B1
W3.9,10,12	+5V	Digital circuits in the analog generator and in UPL-B1
These operating voltages are floating and referred to GND[G].		

All voltages may vary by about ±5 % depending on the regulator and the typical load currents.

The generator ground GND[G] can best be connected on the analog unit at the screening panel of the generator.

5.2.14 Low Distortion Generator (A26)

- Replacing the module

  ▷ Open the UPL (see section 5.2.1.2, page 5.11).

  ▷ Place the instrument upside down so that the bottom of the instrument points towards the top.

- ▷ Loosen the 2 screws fastening the module to the analog unit by means of a Phillips screwdriver size 1.
- ▷ Take the module out of the red plastic supports towards the left.
- ▷ Disconnect cable connection W100 to the analog unit.
- ▷ For replacement, proceed in the reverse order to that of removal.

- Adjustment after module replacement.
  - ▷ No manual adjustment is required.

    NOTE: The frequency response is factory-adjusted and is not affected by the circuits on the analog unit.
  - ▷ Call the automatic adjustment routine, see section 3.3.2.2, page 3.16.

- Testing after module replacement

  NOTE:

  Just to determine whether the module works or not, it is sufficient to perform the "short test of analog interfaces" as described in section 5.1.1.2 on page 5.1.

Short performance test

- ▷ Level accuracy with 1 V, 1 kHz, Output Unbal, channel 1.
- ▷ Frequency response with 2 V, Output Unbal, channel 1.
- ▷ Frequency accuracy
- ▷ THD and THD+N with 2.5 V, 1 kHz, Output Unbal, channel 1.

The measurements are described in section 2.2.3 Performance Test UPL-B1, starting at page 2.42.

5.2.15 Digital Audio I/O (A20, A21, A22)

- Replacing the AES Rear Panel (A21)
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect the cable connection W200 to the AES Main Board.
  - ▷ The module with the XLR and BNC sockets is fastened to the UPL rear panel using 2 screws, loosen these screws using a Phillips screwdriver, size 1.
  - ▷ For replacing the module proceed in the reverse order to that of removal.

- Replacing the AES Main Board (A20)
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect the cable connections W100 and W200 to the AES Rear Panel and AES Front Panel.
  - ▷ If the PC Mainboard 486 covers the AES Main Board to a large extent, first remove the AES Rear Panel, the option UPL-B5 (Audio Monitor, module A50), if installed, and the PC Mainboard (A7).

    PC Mainboard: see section 5.2.11, page 5.20.

    UPL-B5: see section 5.2.16, page 5.24.
  - ▷ The AES Main Board is directly inserted on the digital board (A9) by means of two connectors X40 and X50 and fastened with 3 screws; loosen these screws using a Phillips screwdriver size 1.
  - ▷ Smoothly lift the module and separate it from the digital board.
  - ▷ For replacing the module, proceed in the reverse order.
  - ▷ When replacing the module, first insert it at the two connectors X40 and X50 on the digital board by exerting a uniform pressure.

- Replacing the AES Front Panel (A22)
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect the cable connection W100 to the AES Main Board.
  - ▷ Remove the 4 screws at the corners of the front panel using a Phillips screwdriver size 1.
  - ▷ The front panel unit need not be removed.
  - ▷ Withdraw the rotary knob from the front panel.
  - ▷ Remove the 5 small, light-grey countersunk screws in the labelled front panel using a Phillips screwdriver size 0 and take off the front panel.
  - ▷ The module with the digital inputs and outputs is fastened to the UPL front panel by means of 3 countersunk screws; loosen these screws using a Phillips screwdriver size 1 and remove the module.
  - ▷ For replacing the module, proceed in the reverse order to that of removal.

- Adjustment after module replacement (A20, A21 or A22)
  - ▷ No manual adjustment is required.

NOTE: The modules AES Main Board and AES Front Panel are factory-adjusted. The AES Rear Panel does not require any adjustment.

If the Option UPL-B22 (Jitter and Interface Test) is installed, call up the automatic adjustment routine, see section 3.3.5, page 3.24.

- Testing after module replacement
  - ▷ Check the digital test function THD+N
  - ▷ If the Option UPL-B22 is installed, perform the measurement Input/Ref phase shift.

The measurements are described in the section 2.2.4.1 Performance Test UPL-B2, starting at page 2.50 and page 2.56.

5.2.16 Audio Monitor (A50, E53, W52)

- Replacing the module
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).
  - ▷ Disconnect cable W10 from the UPL-B5 to connector X3 of the digital board.
  - ▷ Disconnect cable W52 (to the headphone jack) on the board at connector X20.
  - ▷ Remove the 2 Phillips screws at the right outside of the instrument (Phillips screwdriver, size 1).
  - ▷ Take the complete unit including speaker, printed circuit board and sheet-metal frame with lugs out of the slots. Slightly lift the option for this purpose. In the event that the lugs cannot be pushed out of the slots, it is recommended to use a screwdriver for levering the lower lug towards the top (using the lateral outer rail as support).
  - ▷ For replacing the option, proceed in the reverse order to that of removal.

- Replacing the speaker (E53)
  - ▷ Remove the complete module as described above.
  - ▷ The speaker is fastened to the support plate using two screws and connected to the board via flat cable W53. Loosen these connections.

- Replacing the headphone jack (W52)
  - ▷ Open the UPL (see section 5.2.1.2, page 5.11).

▷ Disconnect cable W52 (to headphone jack) on the board at connector X20.
▷ Place the instrument upside down so that the bottom of the instrument points towards the top.
▷ Loosen the countersunk screw above the headphone jack in the front frame (Phillips screwdriver, size 1).
▷ Slide the bracket supporting the headphone jack towards the rear and pull the flat cable through the intermediate sheet.

- Adjustment after module replacement

  No adjustment is required.

- Testing after module replacement

  For checking the function, internally connect the analog generator of the UPL to the input of the analog analyzer:

  ▷ Load default setup
  ▷ Set the generator:
    - `Frequency 1.0000 kHz`
    - `Voltage 1.0000 V`
  ▷ Set the analyzer:
    - `Channel(s) 2 ≡ 1`
    - `Input GEN CROSSED`
  ▷ Switch on the speaker in the analyzer panel: `INPUT CH1&2`.
  ▷ Vary the volume by changing the volume setting.
  ▷ Set the speaker to `FUNCT CH1&2` and vary the volume (set `Pre Gain` to 0 dB).

5.3 Spare Parts and Replacement Parts

Spare parts and replacement parts can be ordered via the appropriate R&S representative or directly via R&S, Zentralservice München.

All modules forming the UPL and interconnection cables between modules are shown in circuit diagram of UPL 1078.2008.01S, see Volume 2, Register 1.

The exact designations as well as the stock numbers (= order numbers) of the parts are to be found in the parts list for the UPL and the options in Volume 2 of the Service Manual.

The parts marked with *) can also be obtained as replacement parts. The order number must contain the version 98, i.e.:
1078.2908.02 for analog unit as spare part,
1078.2908.98 for analog unit as replacement part.

5.3.1 UPL Complete Instrument without Options

(see also parts list 1078.2008.01 SA in Volume 2, Register 1)

A1 *)	Power supply board (rectifiers, electrolytic capacitors, voltage regulators)
A2	Front set, consisting of: Panel (front panel + option cover) and Keyboard unit (keyboard and associated board). Panel and keyboard unit can also be obtained separately, see parts list UPL.
A3 *)	Analog unit
A4	DC/AC converter (high-voltage generation for LCD illumination)
A5	Floppy disk drive
A6	Hard disk
A7	PC mainboard
A8	Rotary knob
A9 *)	Digital board
A10 *)	Power supply (Complete power supply unit, contains A1, S1, T1, X1 and Z1)
A20	Front module (contains A2, A4, A8 and H1)
A70	Memory module for PC mainboard
A71	AT-bus adapter (connecting board between digital board and PC mainboard)
A90	XLR adapter (for manufacturing reasons, this module belongs to the digital unit, the circuit documents are also to be found there)
D7	CPU for PC mainboard

E1	Fan
F1, F2	Fuses
H1	LC display NOTE: During replacement a self-adhesive dust shield has to be fastened around the viewing area of the new display. It is **not** shipped with H1, but has to be extra ordered (65cm long, order no. 0852.1805.00).
S1	Power switch
T1	Power transformer
W10 – W75	Various connecting cables, a detailed list is to be found in the parts list for the UPL (complete instrument) in volume 2, register 1
X1	Flat connector (in the power supply unit)
Z1	Line filter

5.3.2 Low Distortion Generator (Option UPL-B1)

(see also parts list 1078.4400.01 SA in Volume 2, Register 5)

A26 *)	Complete module
W100	Cable to analog unit

5.3.3 Digital Audio I/O (Option UPL-B2)

(see also parts list 1078.4000.01 SA in Volume 2, Register 6)

A20 *)	AES main board
A21	AES front panel with cable
A22	AES rear panel with cable

5.3.4 Audio Monitor (Option UPL-B5)

(see also parts list 1078.4600.01 SA in Volume 2, Register 7)

A50 *)	Board with components
W52	Headphone jack with cable
W53	Cable to loudspeaker
E53	Loudspeaker

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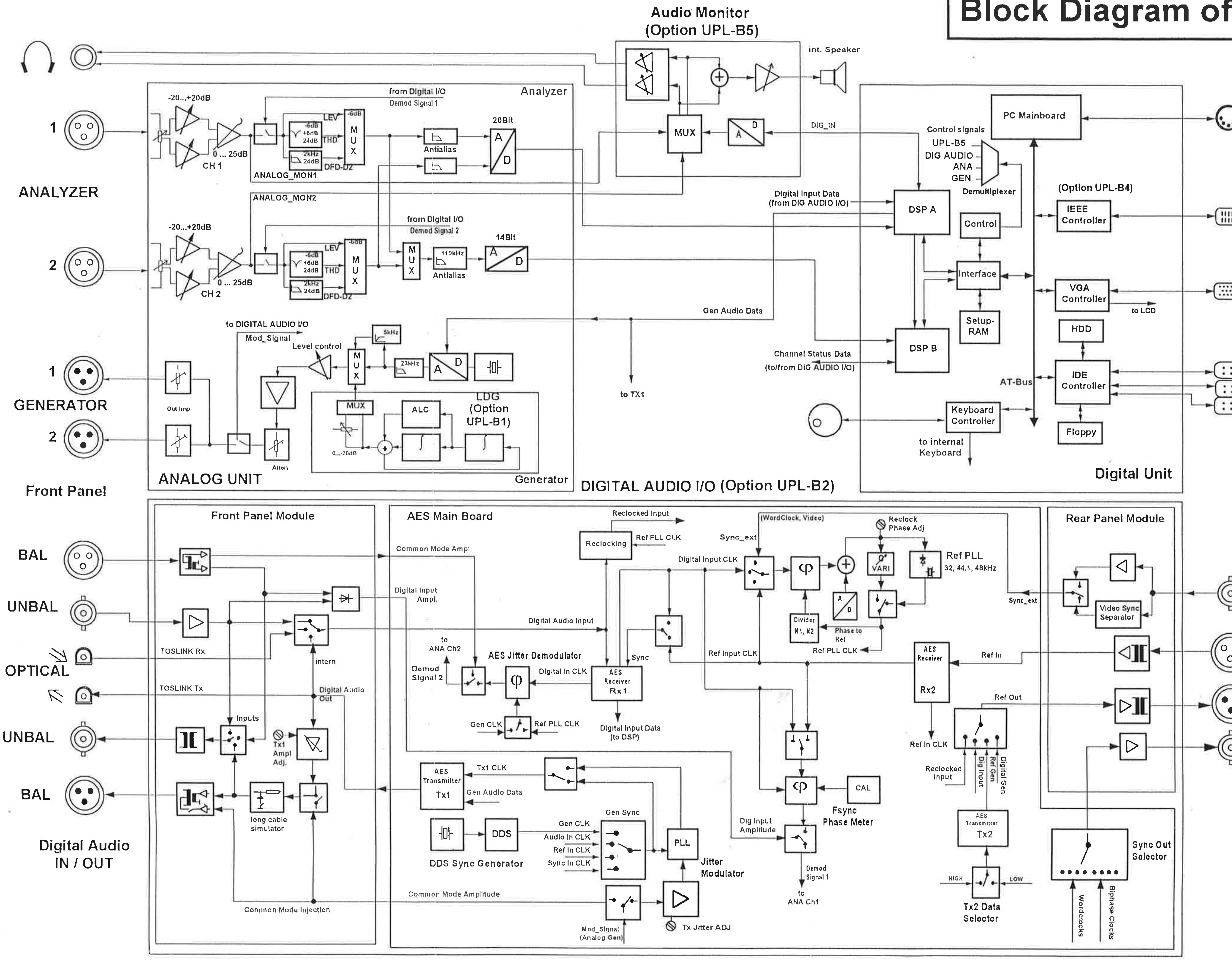
Block Diagram of UPL



ID	1078.2008
ÄI	01
Date	06/19/96
Name	Küfner
Dep	1GP2