Elektrische Messtechnik (5.2)

mod. SS 2009

Prof. Dr. sc. nat. Manfred Schmidt
Fachhochschule Jena
Fachbereich Elektrotechnik/
Informationstechnik

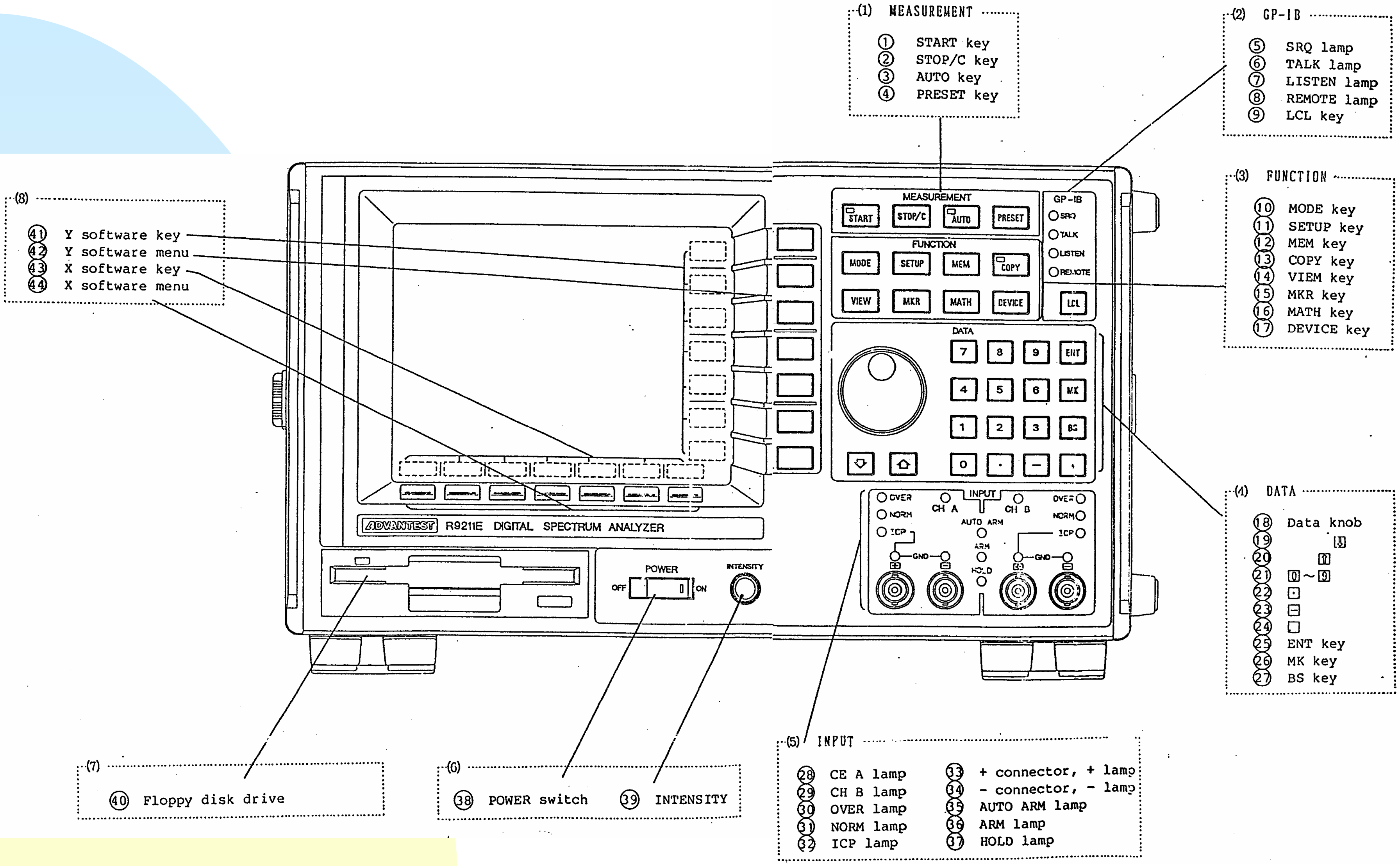
FACH
HOCH
SCHULE
JENA
UNIVERSITY OF APPLIED SCIENCES

Dieses Material wurde ausschließlich für Lehrveranstaltungen am Fachbereich Elektrotechnik und Informationstechnik der Fachhochschule Jena im SS 2003 konzipiert und zusammengestellt.

Die verwendeten Abbildungen sind zum Teil aus den angegebenen Literaturstellen entnommen.

FFT - Analysator

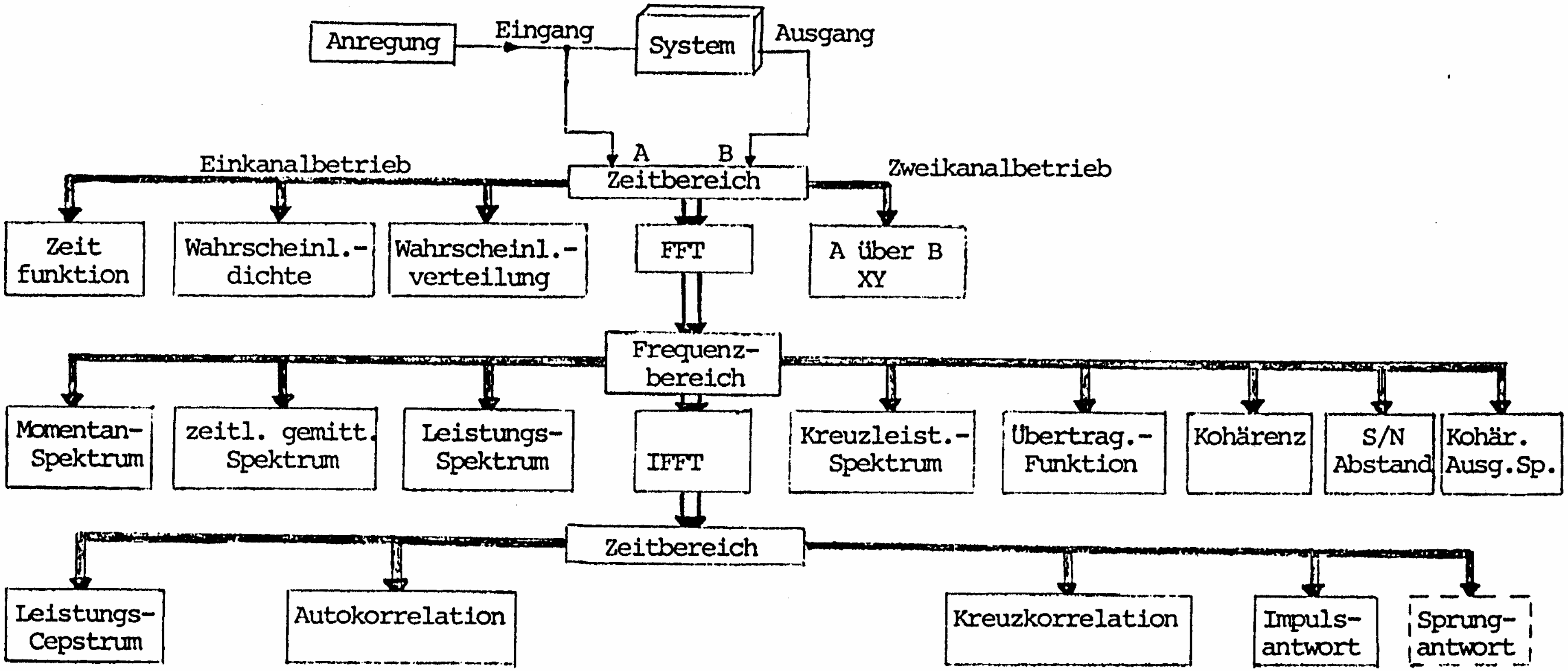
- **Serie R9211 von ADVANTEST**
- **Anfang der 90er Jahre**
- **Gerät wird im Praktikum verwendet**
- **Prinzipieller Aufbau**
- **Menügesteuerte Messung erfordert die Verwendung des Handbuches**



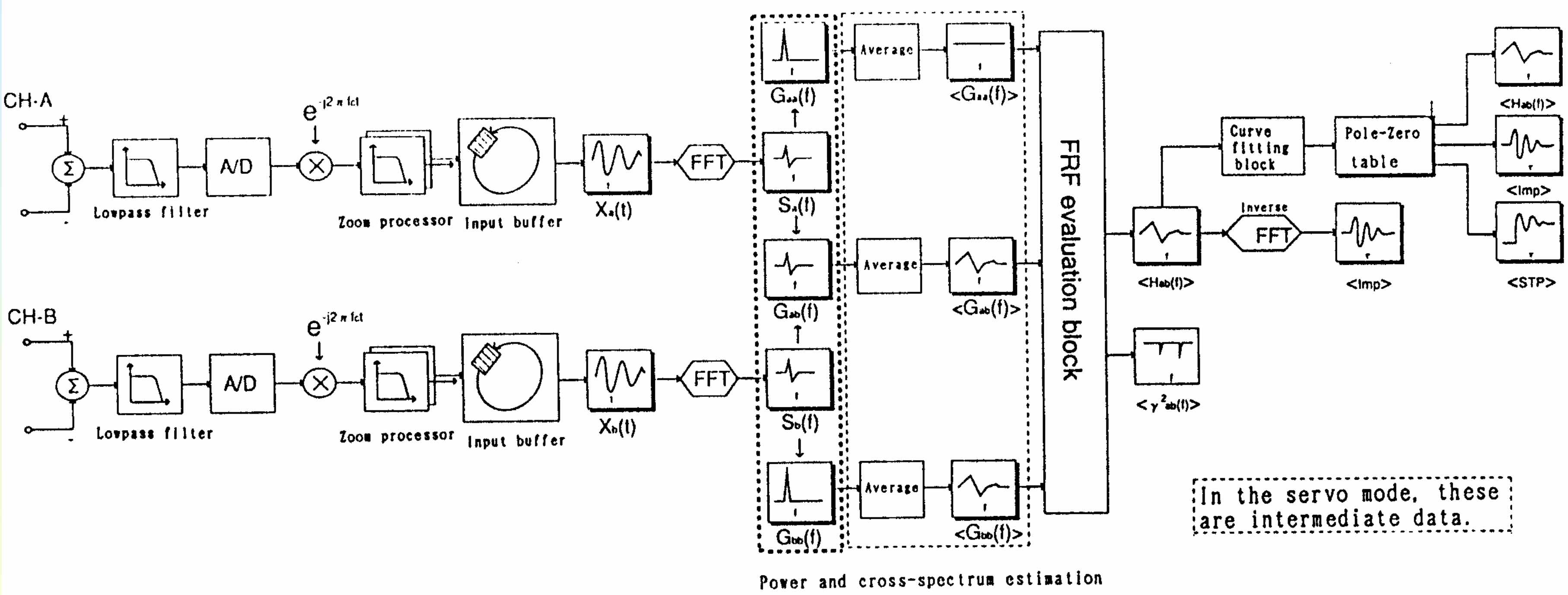
(1) MEASUREMENT
① START key
② STOP/C key
③ AUTO key
④ PRESET key
(2) GP-IB
⑤ SRQ lamp
⑥ TALK lamp
⑦ LISTEN lamp
⑧ REMOTE lamp
⑨ LCL key
(3) FUNCTION
⑩ MODE key
⑪ SETUP key
⑫ MEM key
⑬ COPY key
⑭ VIEM key
⑮ MKR key
⑯ MATH key
⑰ DEVICE key
(4) DATA
⑱ Data knob
⑲ ⇩
⑳ ⇧
㉑ 0 ~ 9
㉒ .
㉓ −
㉔ ,
㉕ ENT key
㉖ MK key
㉗ BS key
(5) INPUT
㉘ CE A lamp
㉙ CH B lamp
㉚ OVER lamp
㉛ NORM lamp
㉜ ICP lamp
㉝ + connector, + lamp
㉞ − connector, − lamp
㉟ AUTO ARM lamp
㊱ ARM lamp
㊲ HOLD lamp
(6)
㊳ POWER switch
㊴ INTENSITY
(7)
㊵ Floppy disk drive
(8)
㊶ Y software key
㊷ Y software menu
㊸ X software key
㊹ X software menu
ADVANTEST R9211E DIGITAL SPECTRUM ANALYZER
MEASUREMENT
START
STOP/C
AUTO
PRESET
GP-IB
SRQ
TALK
LISTEN
REMOTE
FUNCTION
MODE
SETUP
MEM
COPY
VIEW
MKR
MATH
DEVICE
LCL
DATA
7 8 9 ENT
4 5 6 MK
1 2 3 BS
0 . − ,
INPUT
OVER
NORM
ICP
CH A
CH B
AUTO ARM
ARM
HOLD
GND
POWER
OFF
ON
INTENSITY

FFT – Analysator:

Analysefunktionen

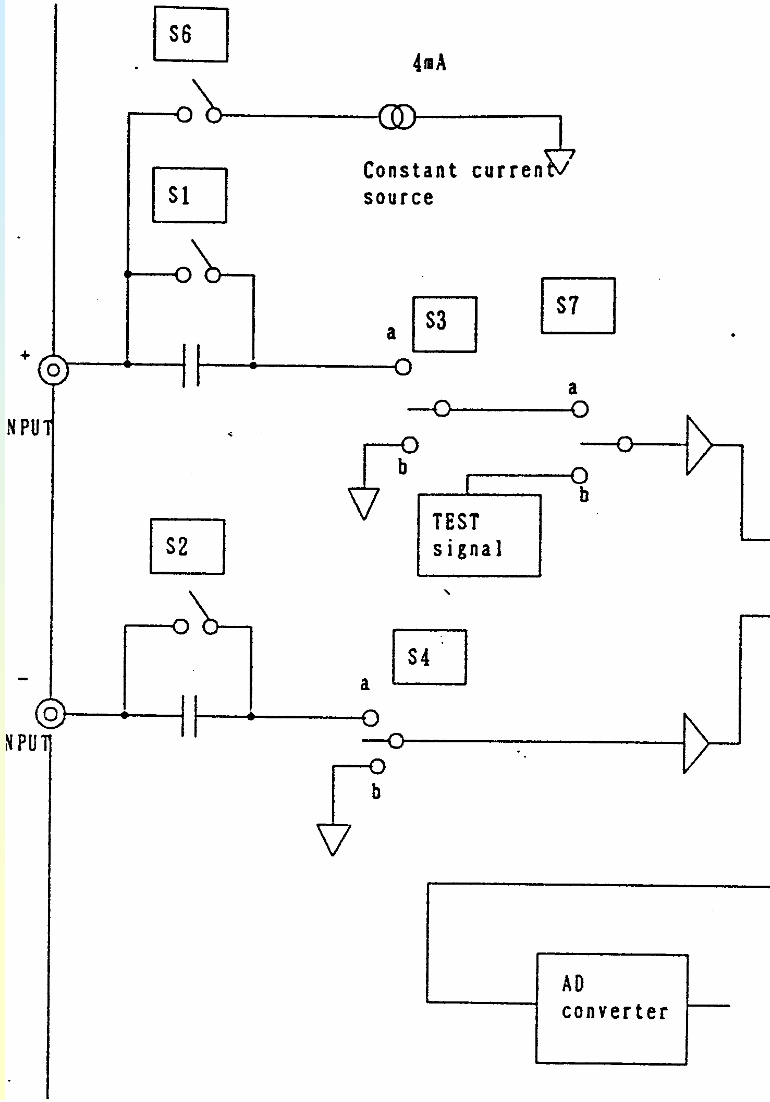


FFT – Analysator R 9211



FFT – Analysator:

Eingangskonfiguration



Geräteeingangs-Beschaltung

S6 ICP Konstantstromquelle für Aufnehmerspeisung

S1 / S2 DC Kopplung

S3 / S4 symmetrischer Eingang

S5 Anti Aliasing Filter

S7 Test Signal

FFT – Analysator R9211

Eingangs-Impedanz/maximale Eingangsspannung

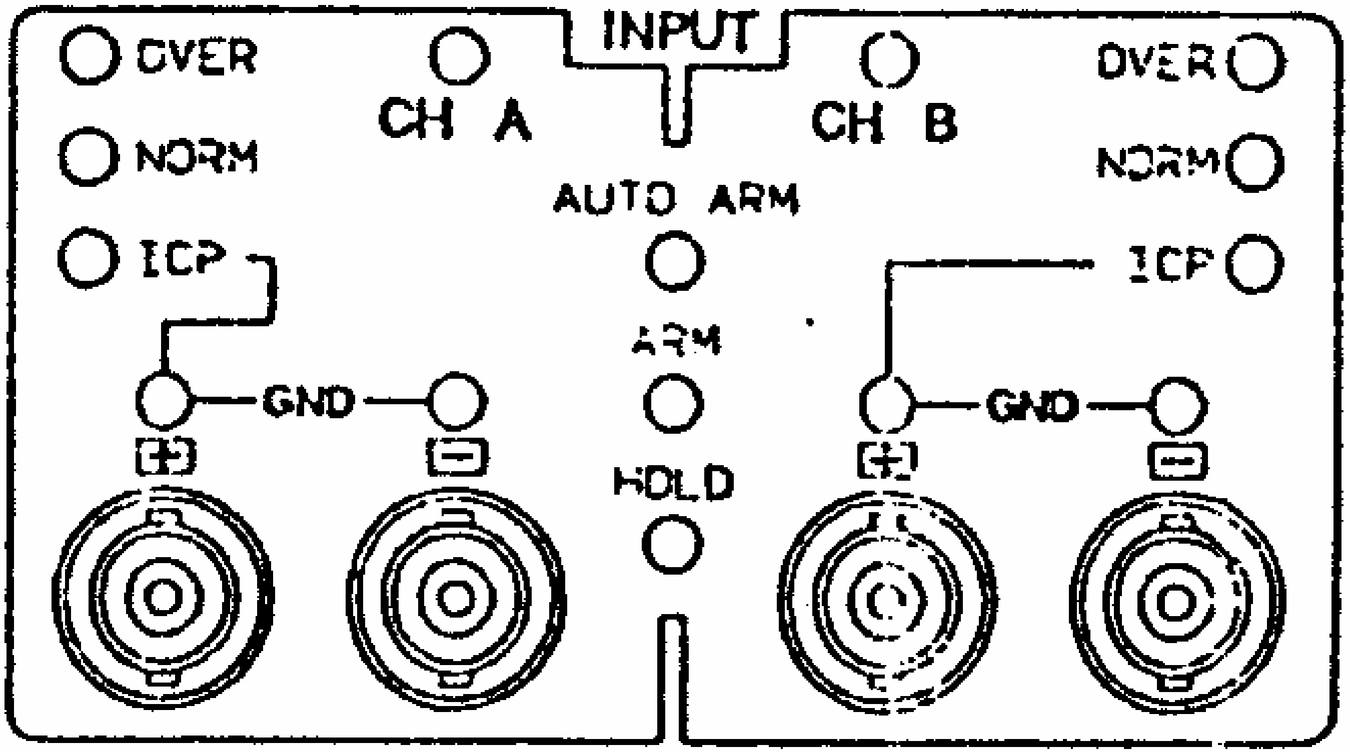
Withstand voltage / Resistance	+ input	- input	GND	Frame
+ input		400V peak	200V peak	200V peak
- input	2MΩ		200V peak	200V peak
GND	1MΩ	1MΩ		0V
Frame	1MΩ	1MΩ	Short (0Ω)	

FFT – Analysator R9211

Differenzeingang

Input mode	Menu setting	AC/DC	+GND/IN	-GND/IN
Differential	AC coupling	AC	IN	IN
	DC coupling	DC		
Single end + input	AC coupling	AC	IN	GND
	DC coupling	DC		
Single end - input	AC coupling	AC	GND	IN
	DC coupling	DC		

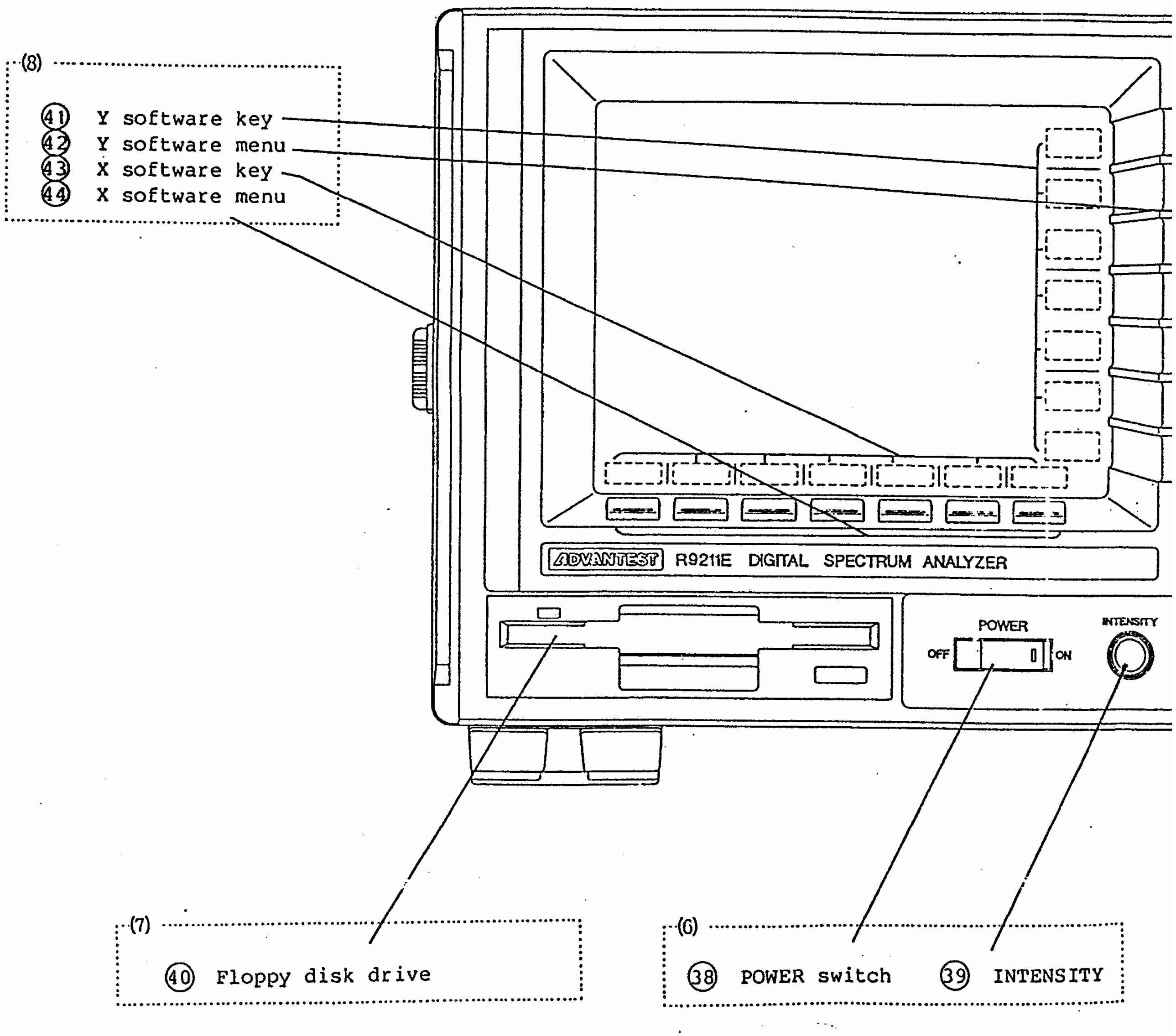
FFT – Analysator R9211



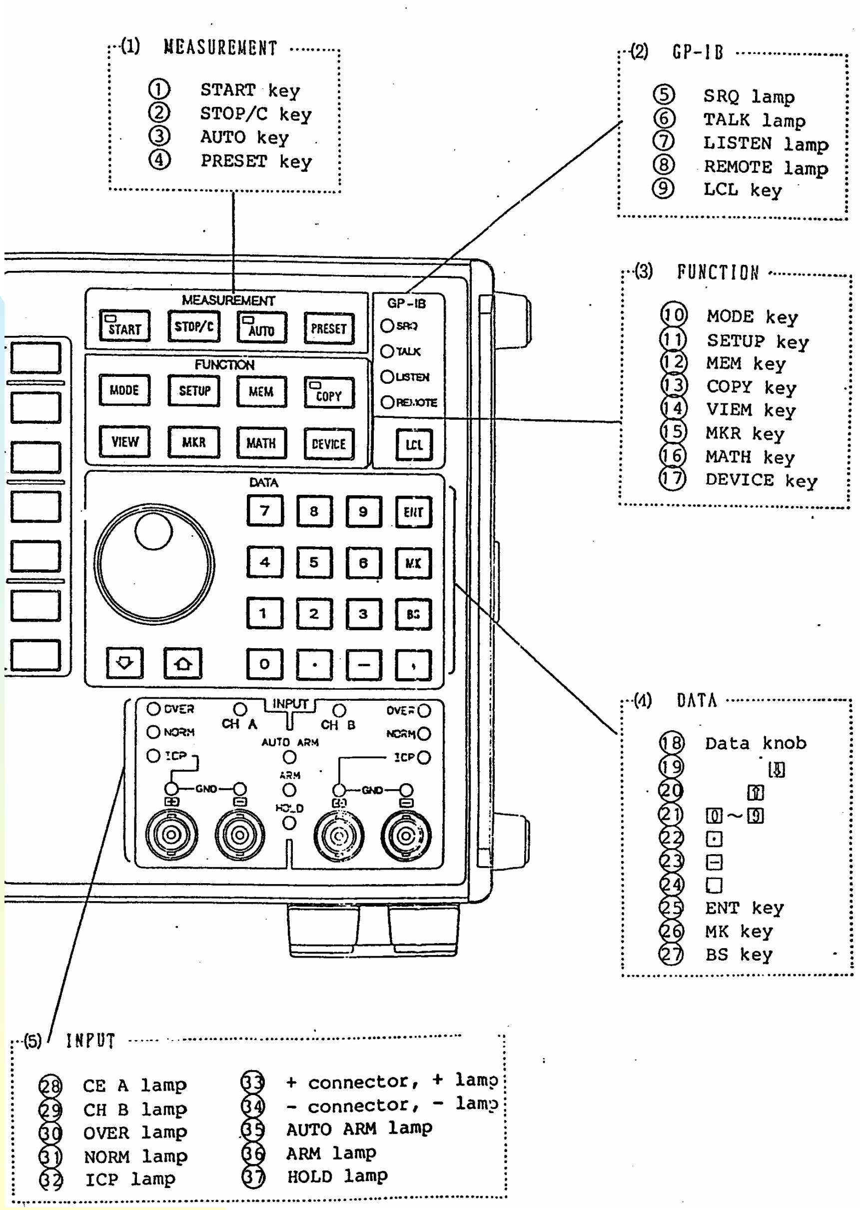
FFT – Analysator R9211

OVER	:	Eingangsüberlastung, Meßbereich erhöhen oder in AUTO RANGE
NORM	:	Meßbereich angepaßt an Signalpegel
CHA/B	:	Anzeige welcher Kanal aktiviert ist
ICP	:	Aufnehmerspeisung eingeschaltet (Menü SET UP/INPUT) ICP = Integrated Circuit Piezoelectric
AUTO ARM	:	Triggereinstellung, Signalspeicher
ARM	:	siehe Seite 272
HOLD	:	siehe Seite 272
GND +/-	:	Eingangskopplung (Menü SET UP/INPUT)

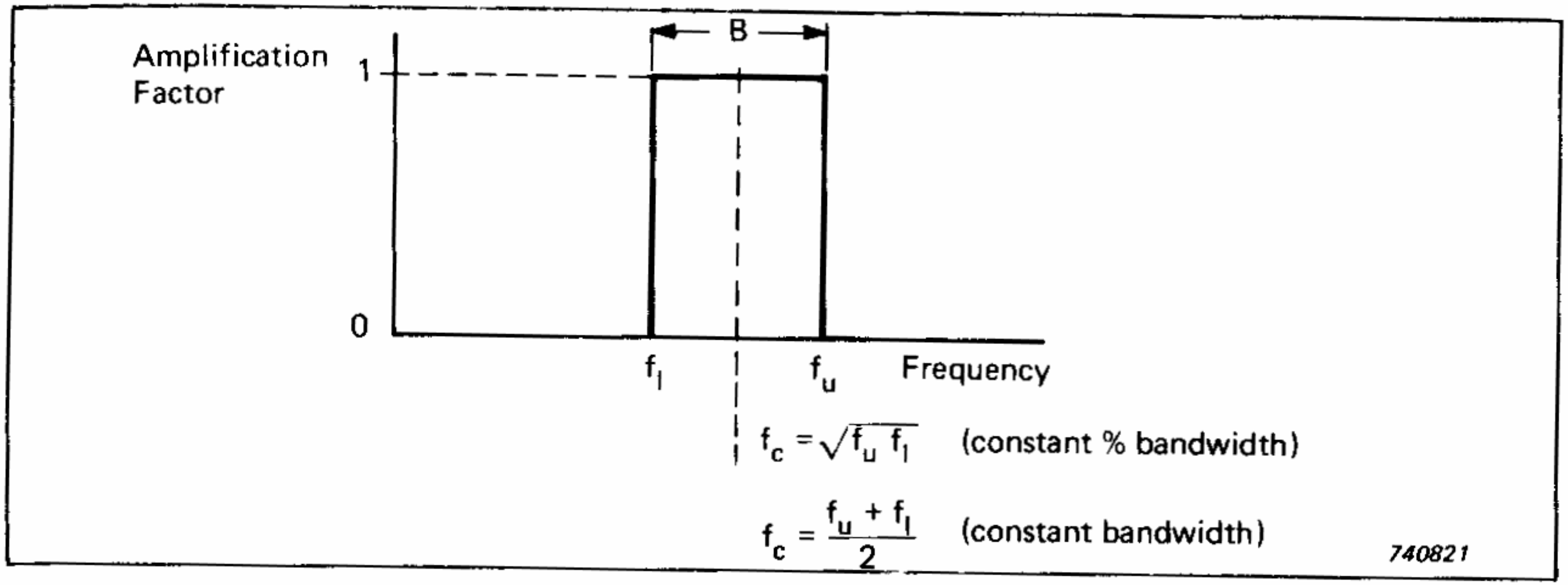
FFT – Analysator R9211

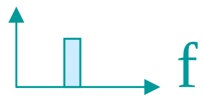


FFT – Analysator R9211



Bemerkungen zur Bandbreite



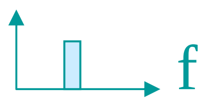


Octav Filter

If f_l = lower limiting frequency
f_u = upper limiting frequency
f_o = nominal centre frequency

Then $f_u = 2f_l$

and f_o = the geometric mean $= \sqrt{f_u \cdot f_l} = \sqrt{2f_l^2} = \sqrt{2}\ f_l$



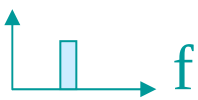
Octav Filter

$$\text{The absolute bandwidth} = f_u - f_l = f_l$$

$$\text{and the relative bandwidth} = \frac{f_u - f_l}{f_o}$$

$$= \frac{f_l}{f_o} = \frac{f_l}{\sqrt{2} f_l} = \frac{1}{\sqrt{2}} = 70{,}7\%$$

Internationally standardized centre frequencies for octave filters are laid down in IEC Recommendation 225 which specifies a set of contiguous filters based on a reference centre frequency of 1000 Hz.



Relation

Internationally standardized centre frequencies for octave filters are laid down in IEC Recommendation 225 which specifies a set of contiguous filters based on a reference centre frequency of 1000 Hz.

Thus it can be seen that it is possible to cover 3 decades in frequency with 10 octave bands ranging from 22,5 Hz (lower limiting frequency for 31,5 Hz centre frequency) to 22,5 kHz (upper limiting frequency for 16 kHz centre frequency).

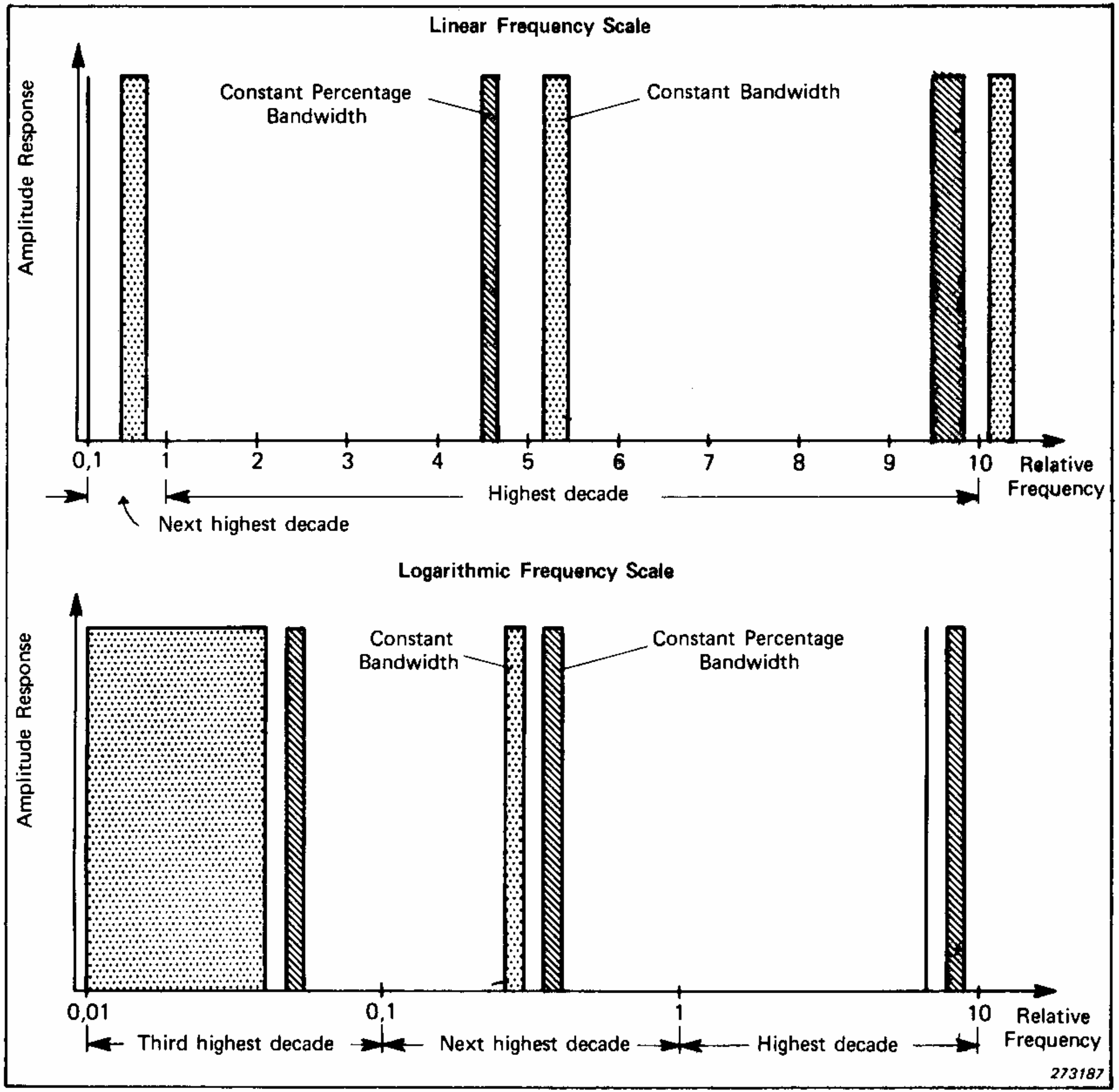
Third Octave Filter

Third octave filters are obtained by dividing each octave band into three geometrically equal sub-sections, i.e. $f_u = 2^{1/3} f_l$ and by coincidence this is equal to one-tenth of a decade since

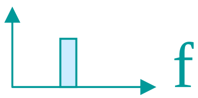
$$log_{10}(2^{1/3}) = {}^{1}\!/_{3}\, log_{10}(2) = {}^{1}\!/_{3} \cdot 0{,}3 = 0{,}1 = {}^{1}\!/_{10}\, log_{10}(10) = log_{10}\ (10^{1/10})$$

By the same procedure as for octave filters, the percentage bandwidth of third octave filters can be derived as:

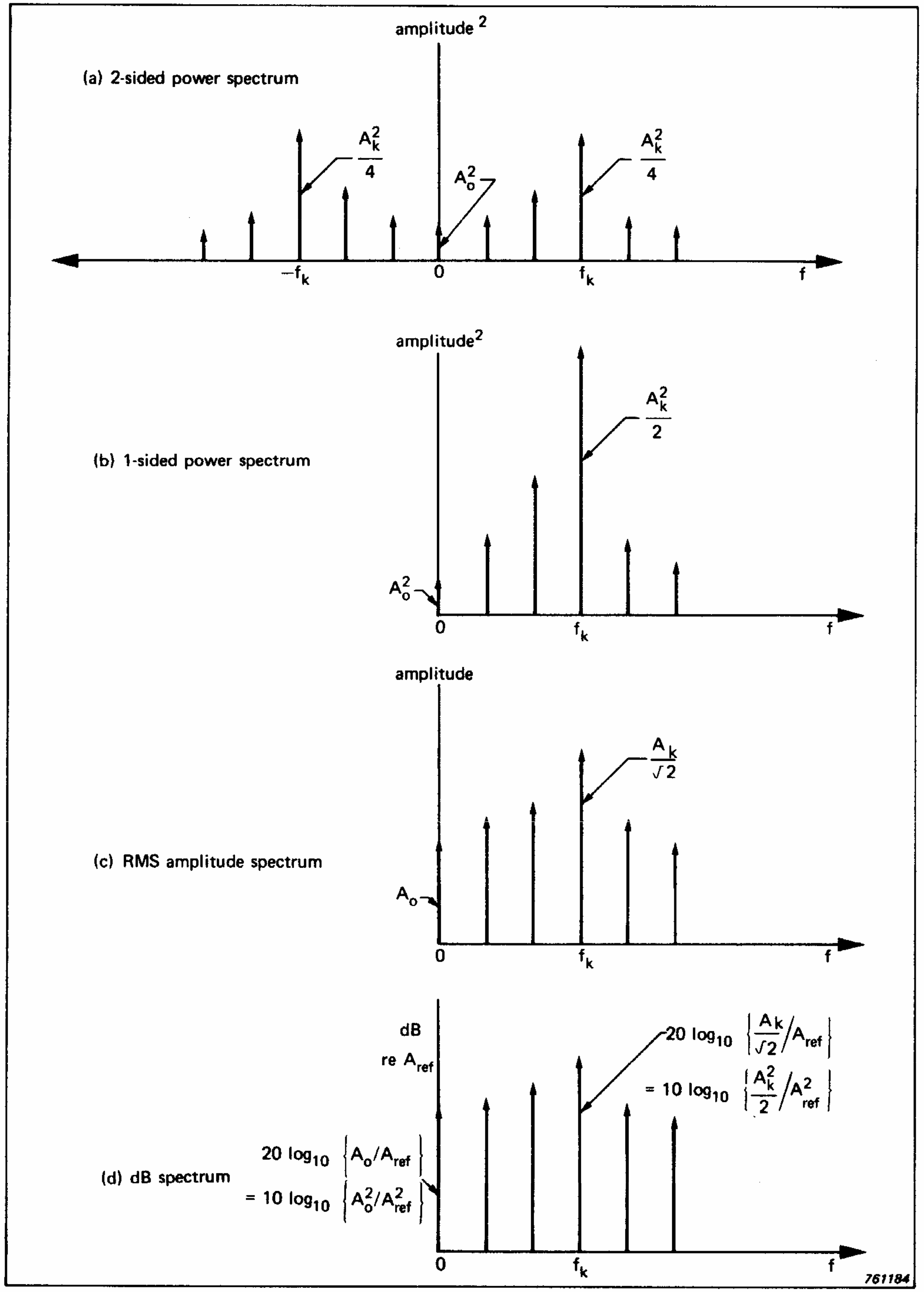
$$\frac{2^{1/3} - 1}{2^{1/6}} = 23{,}1\%$$

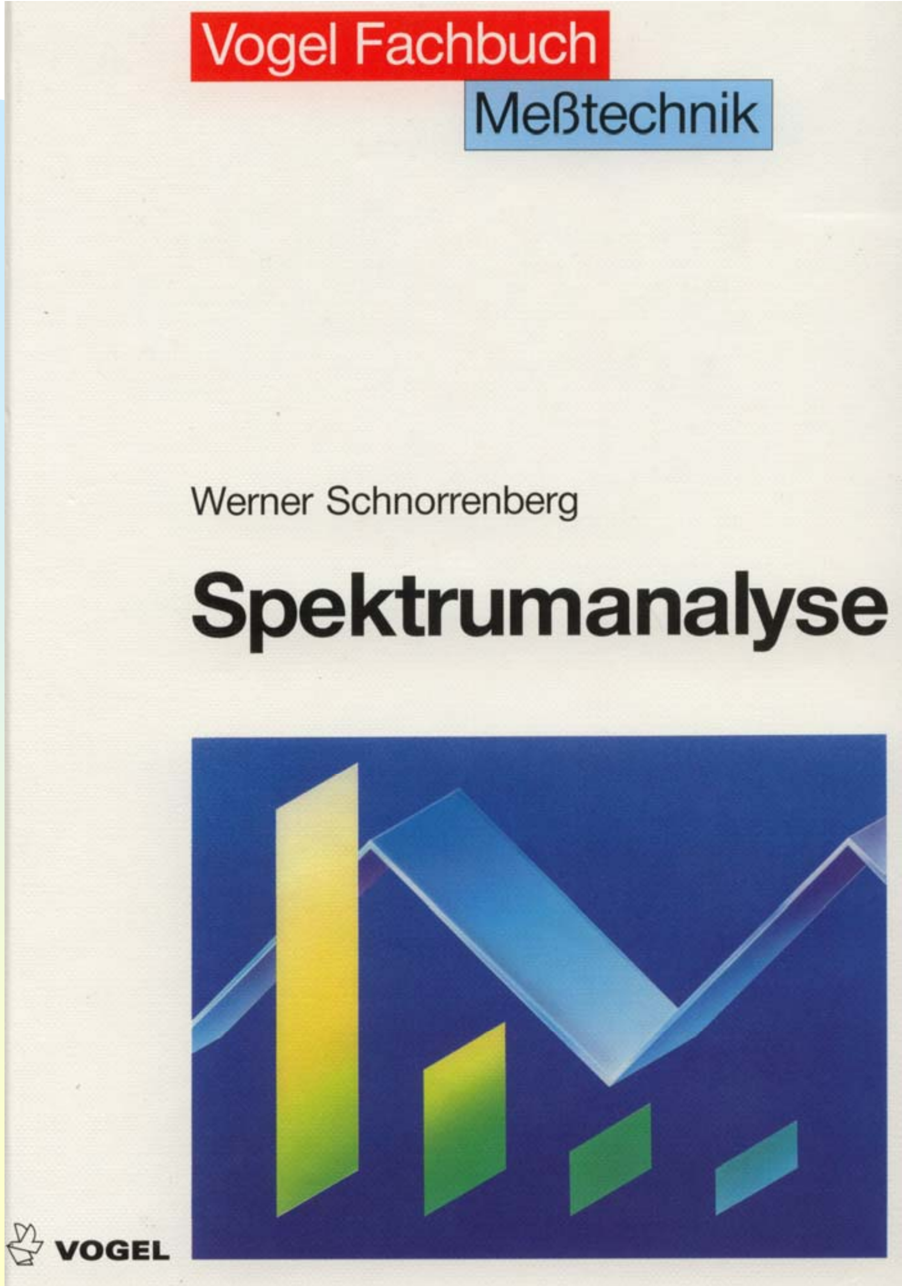


Konstante absolute bzw. relative Bandbreite



Various Spectrum Representations





Literatur

Thumm, M.; Wiesbeck, W.; Kern, St.: Hochfrequenzmeßtechnik. Stuttgart: Teubner, 1997

Literatur

Firmenschriften: Agilent
Rohde & Schwarz
ADVANTEST

Application Notes: Agilent
Rohde & Schwarz

RAUSCHER, Chr.: Grundlagen der Spektralanalyse
R&S München 2004