Instrument setting	Response
LEVEL:AF:ON L:AF:ON	Switch on modulation generator
LEVEL:AF:OFF L:AF:OF	Switch off modulation generator
LEVEL:AF:BOOST:ON L:AF:BO:ON	Level increased by 20 dB at output MOD GEN 83
LEVEL:AF:BOOST:OFF L:AF:BO:OF	Switch off increase in level
LEVEL:AF:VOLTAGE [XYZ] L:AF:V [XYZ]	Setting the output level at output MOD GEN
LEVEL:RF:ON L:RF:ON	Switch on RF output level
LEVEL:RF:OFF L:RF:OF	Switch off RF output level
LEVEL:RF:BOOST:ON L:RF:BO:ON	Output level of RF test generator increased by 6 dB
LEVEL:RF:BOOST:OFF L:RF:BO:OF	Switch off increase in level
LEVEL:RF:VOLTAGE [XYZ] L:RF:V [XYZ]	Setting the RF level
LEVEL:RF:FINE [XYZ] L:RF:FI [XYZ]	RF level fine variation
CODE ['XYZ'] COD ['XYZ']	Transmission of data telegram
DELTA_F [XYZ] DEL [XYZ]	Setting the channel spacing

Measurement	Response
DEMODULATION:MAX_PK DEM:MA DEMODULATION:POS_PK DEM:POS_ DEMODULATION:MED_PK DEM:ME DEMODULATION:NEG_PK DEM:NEG_	Call of modulation measurement
DEMODULATION:DISTORTION DEM:DI	Measurement of transmitter modulation distortion
AF_INPUT:LEVEL AF:LE	AF level measurement
AF_INPUT:DISTORTION [XYZ] AF:DI [XYZ] AF_INPUT:SINAD [XYZ] AF:SI [XYZ] AF_INPUT:S/N [XYZ] AF:S/ [XYZ]	Measurement of receiver, distortion, SINAD, S/N value Start of search routines when entering a numerical value, e.g. AF_INPUT :S/N 20 dB
COUNT:RF COU:RF	Switch on RF counter
COUNT:AF:DEMOD COU:AF:DEMOD COUNT:AF:BEAT COU:AF:BE	Measurement of demodulated AF signals
COUNT:AF:EXTERN COU:AF:E	Measurement of frequency at input AF VOLTM

Measurement	Response
RF_INPUT:POWER RF:POW	RF power measurement
RF_INPUT:PROBE RF:PR	RF level measurement with RF millivoltmeter
DECODE DEC	Decoding a tone sequence
ACP [XYZ]	Adjacent-channel power measurement ACP1 or ACP -1 ACP2 or ACP -2

In order to request the CMT to perform a measurement and transfer the result to the controller, a question mark (?) must be set after the last header.

The same applies if instrument settings, such as frequency, output level, or modulation depth, are requested.

Example:

a) COUNT:RF? — Call RF frequency measurement and
COU:RF? — send measured value to controller.

b) MODULATION:INT1? — Call deviation of 1st modulation
MODU:INT1? — generator.

If instrument settings are performed and a question mark (?) appended to the IEC-bus command, e.g.

```
MODE:TX_TEST?
MODE:TX_T?
```

the command is executed but the message

```
* NOT TALKABLE *
```

is read in following the controller command

```
IECIN<address>,<variable>
IECINØ,B$
```

Reference function via IEC bus

In manual mode, the CMT is able to display new measured/setting values referred to a reference value (cf. 2.3.7.6). This is also possible in IEC-bus mode by means of the following commands:

Switch on	Switch off	Effect
REF:POWER REF:POW	REF_CLEAR:POWER REF_:POW	RF power measurement
REF:RF:VOLTAGE REF:RF:V	REF_CLEAR:RF:VOLTAGE REF_:RF:V	RF level setting
REF:PROBE REF:PR	REF_CLEAR:PROBE REF_:PR	RF millivoltmeter
REF:MAX_PK REF:MA	REF_CLEAR:MAX_PK REF_:MA	Modulation measurement (MAX.PK)
REF:POS_PK REF:POS_	REF_CLEAR:POS_PK REF_:POS_	Modulation measurement (+ PK)
REF:MED_PK REF:MED_	REF_CLEAR:MED_PK REF_:ME	Modulation measurement (+/- PK)
REF:NEG_PK REF:NEG_	REF_CLEAR:NEG_PK REF_:NEG_	Modulation measurement (- PK)
REF:INT1 REF:INT1	REF_CLEAR:INT1 REF_:INT1	Modulation setting (INT 1)
REF:INT2 REF:INT2	REF_CLEAR:INT2 REF_:INT2	Modulation setting (INT 2)
REF:EXT REF:EXT	REF_CLEAR:EXT REF_:EXT	Modulation setting (EXT)
REF:LEVEL REF:LE	REF_CLEAR:LEVEL REF_:LE	AF voltmeter

Without additional indication of a reference value, the "REF" commands only produce an effect on the front-panel display (like in manual mode), ie the command IECOUT0,"REF:LEVEL" switches the output of the measured value to 0.0 dB, and the currently displayed measured value is defined as reference value. Using IECOUT0,"REF_CLEAR:LEVEL", the absolute measured value (e.g. 1.00 V) is displayed again.
If a measured/setting value is requested (e.g. IECOUT0,"REF:LEVEL?"), two results are always obtained, namely relative and absolute value. If the reference value is indicated in the REF command, the result is referred to this value and can be requested by the controller via the bus.

Example:

```
IECOUT0,"LEVEL:RF:V  1µV ?"      Set the RF level to 1 µV
IECIN0,A$:PRINT A$

Result displayed on the screen:  1E-6 V


IECOUT0,"REF:RF:V  ?"
IECIN0,A$:PRINT A$

Result displayed on the screen:  0 DB          1E-6 V


IECOUT0,"REF:RF:V 10µV ?"
IECIN0,A$:PRINT A$

Result displayed on the screen:  -20 DB        1E-6 V
```

Controlling the Oscilloscope via IEC Bus

Manual operation of the oscilloscope is simulated by means of the following IEC-bus commands:

Command	Effect
OSCILLOSCOPE:MODE:RIGHT O:MODE:RI	Operating mode setting AC/DC/BEAT/DEMOD/AF
OSCILLOSCOPE:MODE:LEFT O:MODE:L	Operating mode setting AC/DC/BEAT/DEMOD/AF
OSCILLOSCOPE:TIME:UP O:TI:U	Time base setting
OSCILLOSCOPE:TIME:DOWN O:TI:DO	Time base setting
OSCILLOSCOPE:AMPLITUDE:UP O:AM:U	Gain setting
OSCILLOSCOPE:AMPLITUDE:DOWN O:AM:DO	Gain setting

The effect of these settings is only relative to the currently set status. However, a defined basic status can be obtained by means of oscilloscope PRESET
(IECOUT0,"SPECIALFUNCTION:DATA 130").

Mode: AC
Time: 0.2 ms
Amplitude: 0.2 V

Special functions returning a result to the controller

```
IECOUT0,"SPECIALFUNCTION:D 20 ?"        (Battery voltage
IECOUT0,"SPECIALFUNCTION:D 21 ?"         measurements)
IECOUT0,"SPECIALFUNCTION:D 22 ?"

IECOUT0,"SPECIALFUNCTION:DATA 80 ?"     (Squelch measurement)
IECOUT0,"SPECIALFUNCTION:DATA 84 ?"     (Bandwidth measurement)
IECOUT0,"SPECIALINPUT:DATA 152,<f> ?"   (only with option CMT-B10)
IECOUT0,"SPECIALINPUT:DATA 153,<Δf> ?"  (only with option CMT-B10)
```

2.4.4 Examples for IEC-bus Operation

When the CMT is switched on, the IEC-bus address appears in the frequency field. During operation, the IEC-bus address can be changed via special function [B] [100] [SPEC] <address 0 to 30> [SPEC] .

By pressing the key [LOCAL] the CMT can be switched to normal operation.

If the IEC-bus address is e.g. Ø, the following IEC-bus command is possible:

```
IECOUTØ, "FREQUENCY:RF:TX_TEST 10 MHz "
```

Each time the [LOCAL] key is pressed, the command IECDCL should initiate the IEC-bus operation. The following is a complete BASIC program:

```
10 IECDCL
20 IECOUTØ,"MODE:TX_TEST "
30 IECOUTØ,"FREQUENCY:AF:INT1 20 kHz "
40 IECLAD 0
50 IECGTL
60 IECUNL
70 END
```

This program switches the CMT to transmitter mode and sets the frequency of the first modulator to 20 kHz. The IECGTL command terminates the IEC-bus operation and switches the instrument back to normal operation.

For a detailed description of the IEC-bus commands of the controller, refer to the respective operating instructions, since differences occur with a few commands.

The status byte can be read in by the controller via the IEC-bus command

```
IECSPL <address>,<variable>
```

Example of IEC/IEEE-bus remote control of CMT using SRQ

PUC/SCUD syntax

```
100 IECDCL:IECOFFSRQ                          Initialisation
110 IECTIME10:IECTERM10
120 IECOUTO,"*ESE 255"                        Event mask
130 IECOUTO,"*SRE 32"                         SRQ mask
140 :
150 :
160 IECOUTO,"RECALL 1"                        User program
170 O$="SPECIALF:DATA 80?"
180 GOSUB1200:REM CALL MEASUREMENT
190 PRINT"SQUELCH TEST:":PRINTI$
200 PRINTES$
210 :
220 END
999 :
1200 REM SRQ HANDLING ******************
1210 SQ=0:IECOUTO,"*CLS"                      Clear status register
1220 IECSPLO,SP%:REM CLEAR SRQ
1230 IECSRQGOTO1300                           Activate SRQ
1240 IECOUTO,O$                               Call measurement
1250 DUMMY=0:IFSQ=0THEN1250:REM WAIT FOR SRQ
1260 IECOFFSRQ                                Disable SRQ
1270 GOSUB1400:REM FETCH RESULT
1280 GOSUB1500:REM CHECK EVENTS
1290 RETURN
1300 :
1300 REM #### SERIAL POLL                     Serial poll following SRQ
1310 IECSPLO,SPL%
1320 SQ=1
1330 IECRETSRQ
1340 :
1400 REM #### FETCH RESULT                    Fetch results
1410 IECINO,I$
1420 RETURN
1430 :
1500 REM #### EVENT STATUS                    Read event register
1510 IECOUTO,"*ESR?"
1520 IECINO,B$:B=VAL(B$)
1530 IFBAND32THENES$="COMMAND ERROR"
1540 IFBAND16THENES$="EXECUTION ERROR"
1550 IFBAND1THENES$="CMT READY"
1560 IFB=0THENES$="NO EVENT OCCURRED"
1570 RETURN
READY.
```

Example for bandwidth measurement

```
10 REM
20 REM                          Bandwidth measurement
30 REM
40 IECDCL
50 IECSPE
60 IECOUTØ,"*ESE 255"
70 IECOUTØ,"*SRE 32"
80 ON SRQ GOTO 200
90 IECOUTØ,"SPECIALF: DATA 84?"
.
.
.
200 IECSPLØ,A%
210 IF A% = 96 THEN GOTO 300
220 GOTO 1000
.
.
.
300 IECOUTØ,"*ESR?"
310 IECINØ,B$ : B = VAL(B$)
320 IF B = 32 THEN ...          Command Error
330 IF B = 16 THEN ...          Execution Error
340 IF B = 1  THEN ...          Operation complete
.
.
.
1000 END
```

2.4.5 Device-independent Commands

Device-independent commands refer to

- reset commands
- service request function
- device identification

The headers consist of a star (*) followed by three letters.

Table 2-5 Device-independent commands

Header	Meaning
*CLS	**Clear Status** Sets status registers (ESR und STB) to zero.
*ESE 0 to 255 *ESE?	**Event Status Enable** Sets the mask register to 0 to 255 or reads out the register.
*SRE 0 to 255 *SRE?	**Service Request Enable** Sets the mask register to 0 to 255 or reads out the register.
*IDN?	**Identification Query** Identification of the device with the reply ROHDE & SCHWARZ CMT.
*ESR?	**Event Status Register Query** Output of the event status register.
*STB?	**Status Byte Query** Reads out the register.
*OPT?	**Options** Display of options fitted The Output has the following meaning: 0000 0111 0001 1111 2nd AF Synthesizer (CMT-B7) Oscilloscope Autorun Control (CM-B5) IEC Bus (CM-B4) Duplex Modulation Meter (CM-B9) DTMF Decoder (CM-B11) RF Millivoltmeter (CM-B8) Adjacent-channel Power Meter (CMT-B6)

2.4.5.1 Service Request and Status Registers

Fig. 2-17 shows the status registers and the links between them. In line with the standard, the status byte (STB) and its associated mask register (SRE), which are also present with older instruments, have been supplemented by the event status register (ESR) and its event status enable (ESE) mask register.

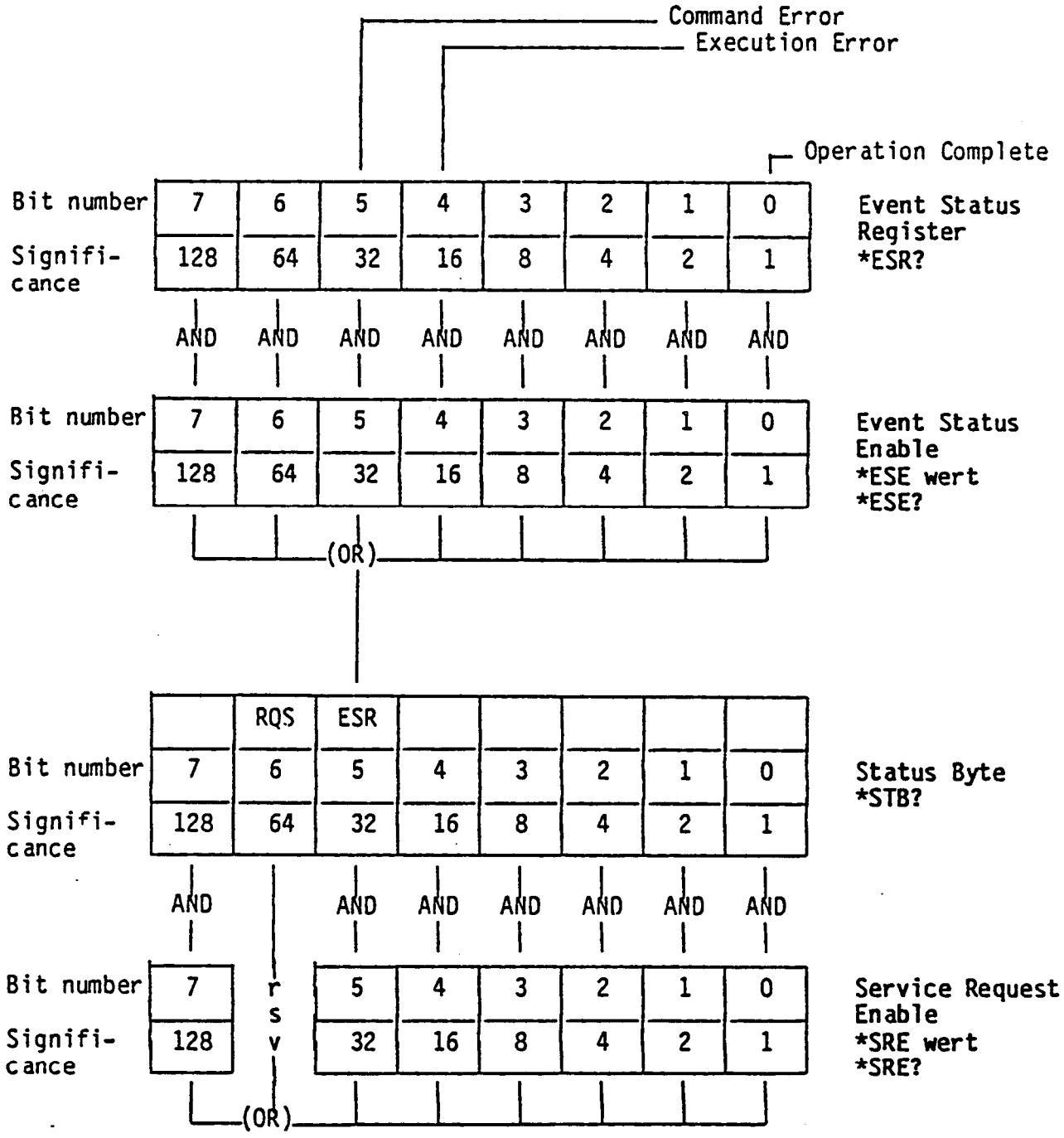


Fig. 2-17 Status register

Table 2-6 Significance of event status register

Bit 5	**Command Error** is set if the following errors are detected during analysis of the received commands: → syntax error → illegal header → illegal unit
Bit 4	**Execution Error** is set if one of the following messages appears: → ADD OPTION ... → CHECK MOD. → CHECK INST. → TIMEOUT ERROR → >NOT DEFINED< → >ERROR< → *NO CALL* → >PROTECTED< → NOT TALKABLE → ** CH. SP. ** → * SET RF FIRST * → 0V RF / CH.SP. These messages can then be read in via the IECIN command.
Bit Ø	**Operation Complete** is set if all previous commands have been executed.

Using the service request enable mask register (SRE), the user can determine whether the RQS bit of the status byte is also to be set with the ESR bit set and if a service request is to be sent to the controller by activating the SRQ line. The following possibilities exist since each bit in the service request enable mask register is assigned to the corresponding bit in the status byte:

Contents of the SRE (decimal)	Set bit No. in the SRE	Effect
0	-	No service request
32	5	Service request with ESR bit set (at least 1 bit set in the event status register and not masked)

The service request enable mask register (SRE) is written with the command "*SRE wert" ("wert" is the contents in decimal) and can be read again using the command *SRE?. It is not changed by other commands or interface messages (DCL, SDC).

Several devices can trigger a service request simultaneously, the open collector drivers cause an OR function on the SRQ line. The controller must read the status bytes of the devices to identify the device which has triggered the service request. A set RQS bit (bit 6/DIO 7) indicates that the device is transmitting a service request.

The status byte of the CMT can be read in the following manner:

- Using the command "*STB?":
  The contents are output in decimal. The status byte is not modified by reading and the service request is not cleared.

- Using a serial poll
  (With R&S controllers: IECSPL adr, status):
  The contents are transferred in binary form as only byte. The RQS bit is subsequently set to zero and the service request becomes inactive, the other bits of the status byte are not changed.

In the event status register (ESR), a bit is set to 1 (see Table 2-6) if certain events occur (e.g. error, ready message).

These bits remain set until they are cleared by reading the event status register (using the command *ESR? or *CLS).

Using the event status enable mask register (ESE), the user can select the bits in the event status register which also set the sum bit ESR (bit 5 in the status byte). The sum bit is only set if at least one bit in the ESR and the corresponding bit in the ESE are set to 1. The sum bit is automatically cleared again if the above condition is no longer satisfied, e.g. if the bits in the ESR are cleared by reading the ESR or if the ESE is changed.

The event status enable mask register is written with the command "*ESE wert" ("wert" is the contents in decimal) and can be read again using the command *ESE?

It is not changed by other commands or interface messages (DCL, SDC).

Only the following bits are used in the status byte (STB):

Bit No.	Bus line	Designation	Meaning
5	DIO 6	ESR	Sum bit of event status register
6	DIO 7	RQS	Request Service

2.4.6 Special Features of the CMT in Remote Mode (IEC bus and autorun control)

2.4.6.1 Readout of Decoded Selective Call via IEC Bus / Autorun Control

The IEC-bus command IECOUT0,"DECODE ?" starts decoding and delivers as a result the contents of the data telegram received.

In an acknowledgement test (ACK TEST), it must be possible to read out the contents of the data telegram received without having to restart decoding. For this purpose,

```
IECOUT0,"SPECIALFUNCTION:C 186"
```

is used.

This command can also be used in a direct way in manual mode (useful only in LEARN mode of autorun control) and in the autorun control program:

[C] [186] [SPEC]

The IEC-bus command IECOUT0,"DECODE ?" is synchronized, ie it must first be terminated before a further command can be sent to the CMT.

In order to be able to send further commands to the CMT after decoding has been started (e.g. control of the relays on CM-B4 and CM-B5), this synchronization must be suppressed.

For this purpose, the following command sequence is used:

```
IECOUT0,"SPECIALFUNCTION:C 185" (decode unsynchronized)

IECOUT0,"SPECIALFUNCTION:A 31"  (switch relay)

                :
```

Wait for the result or read out the result until the buffer is no longer empty!

```
                :

IECOUT0,"SPECIAL FUNCTION:C 186?" (read out result)
```

This function can also be used with the autorun control!

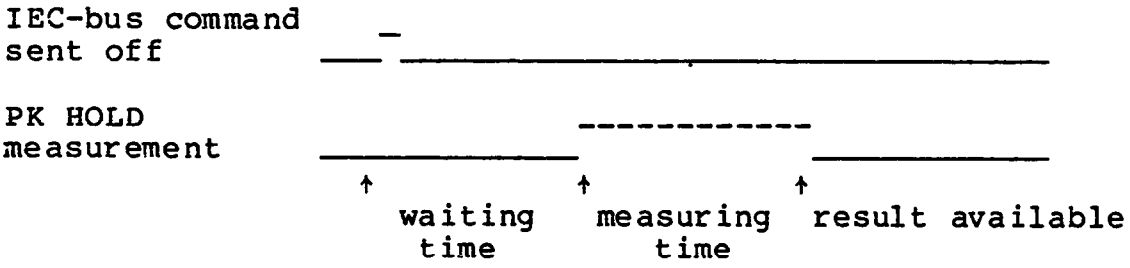
2.4.6.2 PK HOLD Function via IEC Bus and Autorun Control

If the PK HOLD function is switched on in manual mode, the greatest measured modulation value is displayed as a result until the function is switched off.

In addition, particular time conditions are useful in IEC-bus mode:

- Waiting time between incoming IEC-bus command and start of PK HOLD measurement.

- Measuring time (time between start and end of PK HOLD)



These times can be set between 0.1 and 3 s via the two functions

[181] [SPEC] <waiting time(s)> [SPEC] (resolution 0.1 s)
(IECOUT0,"SPECIALINPUT:DATA 181, waiting time")

and

[182] [SPEC] <waiting time(s)> [SPEC] (resolution 0.1 s)
(IECOUT0,"SPECIALINPUT:DATA 182, measuring time")

(factory setting 0.5 s).

The IEC-bus command IECOUT0,"DEMODULATION:PK_HOLD:ON" starts the +PK or -PK measurement with the PK HOLD function activated.

MAX PK
+ PK activated → PK HOLD with +PK
MED PK
- PK activated → PK HOLD with -PK

This command is not synchronized, ie further commands (e.g. switch built-in relays) can be sent to the CMT even before the measurement is terminated.

The measurement result is read out using the command

IECOUT0,"SPECIALFUNCTION:DATA 180?"

and provides the +PK or -PK result (after expiration of the measuring time!).

Operation via the autorun control is performed accordingly.

⚠ With the ACK TEST activated (ACK TEST LED lights) and in manual mode, times entered via [181] / [182] [SPEC] are ignored.
The function [180] [SPEC] can be used in the ACK TEST for reading out the determined deviation in IEC-bus and autorun mode.

2.4.6.3 Automatic Background Calibration of the CMT

Approximately every 10 minutes, the CMT performs a calibration of the A/D converter (incl. preamplifier), the rms meter and the peak-value meter. During calibration, the measuring mode is interrupted for approx. two seconds which may lead to difficulties in time-critical measurements (above all via IEC bus and autorun control).

The automatic calibration can therefore be switched off via [D] [5] [SPEC] .
It can be switched on again via [D] [0] [SPEC] .

2.4.6.4 Waiting Times and Transient of the CMT in IEC-bus Programs

All internal transients of the CMT with respect to switching of amplifiers, attenuators and source selection are taken into account in the individual measurement calls.

In some cases, however, it is not useful to take into account all possible errors in the firmware of the CMT (reduction of measuring rate!):

1. Distortion meter (SINAD/DIST, DIST TX):

If the input voltage varies heavily, the internal CMT control requires up to 6 s until the display of the measured SINAD value is steady and correct. Since the point in time at which such level jumps occur is always known in a fully automatic test program, it is better to wait for the steady-state condition in the control program than reduce the measuring rate in the firmware.

Level jumps at the input AF VOLTM

```
20  IECOUT0,"AF_INPUT:SINAD"   1st measurement call in order to
                               activate SINAD measurement.

30  HOLD 3000                  Waiting time until signal
                               applied is stable

40  IECOUT0,"AF_INPUT:SINAD?"  Perform measurement
```

2. Switchover of type of modulation:

When selecting the MAX PK measurement, the type of modulation can be switched over at the same time via the unit. In order to suppress settling of the demodulators, it is recommended to evaluate the result of a second measurement:

Type of modulation AM is switched on:

```
50  IECOUT0,"DEMODULATION:MAX_PK KHZ"
60  IECOUT0,"DEMODULATION:MAX_PK ?"
```

3. Changing from BEAT/ACP measurement to demodulation:

Demodulation is not possible while a BEAT/ACP measurement is running, since the local oscillator must be converted for this purpose.

This is why this operating mode should be switched off before measuring the demodulated signal.

BEAT measurement active:

```
50 IECOUT0,"DEMODULATION:MAX_PK"      (BEAT is switched off)
60 IECOUT0,"DEMODULATION:MAX_PK ?"
or
60 IECOUT0,"DEMODULATION:DISTORTION"
70 HOLD 3000
80 IECOUT0,"DEMODULATION:DISTORTION ?"
```

ACP measurement active:

```
50 IECOUT0,"RF_INPUT:POWER"           (ACP is switched off)
60 IECOUT0,"DEMODULATION:MAX_PK ?"
or
60 IECOUT0,"DEMODULATION:DISTORTION"
70 HOLD 3000
80 IECOUT0,"DEMODULATION:DISTORTION ?"
```

4. BEAT measurement

The first BEAT measurement in an autorun control program shifts the local oscillator by 455 kHz. This may invalidate the measurement result.

The following program section provides a remedy:

Autorun control:	IEC bus:
023 PRINT OFF	
024 BEAT	50 IECOUT0,"COUNT:AF:BEAT"
025 PRINT ON	
026 BEAT	60 IECOUT0,"COUT:AF:BEAT?"

2.5 Installation of Options

For installation of most options, the instrument must be opened and the plug-in cards pulled out; the information required for this can be obtained from Section 4 (Service Manual).

Note: After fitting the options, the rails must be locked in position and the screws marked A (Fig. 4-2) must be tightened.

2.5.1 IEC Bus and/or Autorun Control (CM-B4/CM-B5)

For fitting this (these) option(s), the instrument need not be opened. Unscrew the cover plate fastened to the rear panel with 6 Phillips screws, break out the corresponding straps and fasten the option(s) with the supplied screws. Slide the cover plate with the option(s) carefully into the instrument and fasten with screws.

When fitting the autorun control option, first enter [A] [800] [SPEC] (initialization) after switching on for the first time.

The adhesive foil supplied with the option may be used as auxiliary means for text input in connection with the autorun control. If required, it can be attached below the three following rows of keys:

E to N below the upper row of keys (f to PROBE)
O to Y below the center row of keys (INT1 to CCITT)
Z to > below the lower row of keys (RECEIVER to LOWER)

2.5.2 OCXO Reference Oscillator (CMT-B1)

Open the instrument and take out the RF oscillator module. Unscrew the labelled panel and plug in the option; do not forget the insulating washer, provided this has not yet been stuck to the bottom side of the OCXO oscillator.

Note: After fitting the option, adjust it (Section 3).

2.5.3 Adjacent-channel Power Meter (CMT-B6)

Open the instrument. Plug the option onto location X55 (black color coding); if the DTMF decoder option (CM-B11) is fitted, plug the adjacent-channel power meter (ACP) onto this option. The module is connected up according to the following plan (see also wiring diagram in the cover):

remove	lay	cable	from	to
x	-	W16	analog unit, X609	analog unit X607
-	x	W20	analog unit, X606	option ACP, X918
-	x	W24	analog unit, X607	option ACP, X916
-	x	W21	RF oscill., X304	option ACP, X911
-	x	W23	analog unit, X609	option ACP, X917

2.5.4 2nd AF Synthesizer (CMT-B7)

Open the instrument. Disconnect the cables W4 and W5 from the 1st modulation generator module, and W26 if option CM-B8 is fitted, (location X56, gray color coding) and pull it out; unscrew the panel without inscription and plug in the option. Fasten the new panel covering both modules and plug in the module; do not forget the cables W4 and W5 (and W26, if necessary).

2.5.5 RF Millivoltmeter (CM-B8)

Open the instrument, take off the inscription panel and remove the front panel (see Section 4, Service manual). Replace the plastic cover by the supplied 3-pole connector. Fit the front panel and the inscription panel again.

Disconnect the cables W4 and W5 from the 1st modulation generator module (location X56, gray color coding) and take it out together with the 2nd AF Synthesizer option (CMT-B7), if plugged in. If only the 1st modulation generator is present, unscrew the panel without inscription, and screw the option to the new panel supplied. If the 2nd AF Synthesizer option (CMT-B7) is fitted, plug the option onto it and use the projecting cover as support. Plug in the modules; do not forget W4 and W5.

2.5.6 Duplex Modulation Meter (CM-B9)

Open the instrument and plug the option onto location X53 (yellow color coding). The module is connected up according to the following plan (see also wiring diagram in the cover):

remove	lay	cable	from	to
x	-	W21	RF oscillator, X304	option ACP, X911
-	x	W21	RF oscillator, X304	option CM-B9, X931
-	x	W22	option CM-B9, X932	option ACP, X911
x	-	W3	output stage, X406	analog unit, X608
-	x	W3	option CM-B9, X939	analog unit, X608

To protect against radio interference, screw the supplied screening cover onto connector X406 of the output stage.

2.5.7 DTMF Decoder (CM-B11)

Before opening the instrument, remove the option Adjacent-channel Power Meter (CMT-B6), if fitted. Plug the option onto location X55 (black color coding) and fit the Adjacent-channel Power Meter again (see Section 2.5.3).

2.5.8 Testing the Fitted Options

The options are checked as described in Section 3.

OCXO Reference Oscillator	CMT-B1	3.2.2.
IEC Bus	CM-B4	3.2.31
Autorun Control	CM-B5	3.2.29
Adjacent-channel Power Meter	CMT-B6	3.2.27
2nd AF Synthesizer	CMT-B7	3.2.15.4
RF Millivoltmeter	CM-B8	3.2.28
DTMF Decoder	CM-B11	3.2.26

The duplex modulation meter CM-B9 is checked according to 3.2.22.2; in addition, vary the frequency of the test generator in the range between 1 MHz and 1000 MHz, preferably use the frequencies as in 3.2.3.

3 Maintenance

3.1 Measuring Instruments and Aids Required

Item No.	o Instrument type, required specifications ● Recommended R&S instrument	Type	Order No.	Application Section
1	o High-frequency meter 0.1 to 1000 MHz Error ≤ 1×10^{-9} Resolution 1 Hz			3.2.2 3.2.3
2	o Power meter 1 to 1000 MHz Z = 50 Ω 1 to 100 mW Error < 0.1 dB ● Power Meter	NAP	392.4017.02	3.2.4 3.2.6
3	o Precision attenuation set 0 to 1000 MHz ● Precision Attenuation Set	DPVP	214.8017.52	3.2.5
4	o Test receiver 10 to 520 MHz ● Test Receiver	ESV	342.4020.52	3.2.5
5	o RF analyzer 1 to 100 MHz Dynamic range > 80 dB			3.2.7 3.2.8

Item No.	o Instrument type, required specifications ● Recommended R&S instrument	Type	Order No.	Application Section
6	o Modulation analyzer 1 to 1000 MHz AM, FM, ϕM Bandwidths: CCITT, 20 kHz, 200 kHz Peak value/rms value evaluation Distortion meter for the demodulated signal and external AF ● Modulation Analyzer	 FAM	 334.2015.54	3.2.9 3.2.10 3.2.11 3.2.12 3.2.13 3.2.15.2 3.2.22 3.2.23 3.2.24
7	o AF generator 10 Hz to 1 MHz ($1x10^{-5}$) 1 mV to 10 V (±1%) ● AF Generator	 SPN	 336.3019.02	3.2.11 3.2.12 3.2.13 3.2.16 3.2.17 3.2.18 3.2.19 3.2.22 3.2.23 3.2.24 3.2.25
8	o AF bandpass filters One-third octave bandpass filters with 300 Hz / 1 kHz / 3 kHz			3.2.11 3.2.12
9	o DC power supply 0 to 20 V, 1 A ● DC Power Supply	 NGT20	 117.7133.02	3.2.14

Item No.	o Instrument type, required specifications ● Recommended R&S instrument	Type	Order No.	Application Section
10	o Power signal generator 25 to 1000 MHz Output power up to 2 W ● Power Signal Generator	 SMLU	 200.1009.03	3.2.14 3.2.28
11	o AF meter 10 to 100 kHz Resolution 0.1 Hz			3.2.15
12	o RF generator 1 MHz to 1 GHz 5 µV to 1 V AM, FM capability ● RF Generator	 SMPC	 300.1000.55	3.2.20 3.2.22 3.2.23 3.2.24 3.2.26 3.2.27 3.2.29
13	o RF power amplifier 1 to 1000 MHz Up to 50 W Z = 50 Ω			3.2.21
14	o Vector analyzer 1 to 1000 MHz ● Vector Analyzer	 ZPV	 291.4012.93	3.2.21
15	o VSWR bridge 10 to 1000 MHz ● VSWR Bridge	 ZRB2	 373.9017.52	3.2.21

Item No.	o Instrument type, required specifications ● Recommended R&S instrument	Type	Order No.	Application Section
16	o Selective call generator			3.2.26
	● Selective Call Generator	SCUD	393.7110.02	
17	o IEC-bus controller IEC 625 standard			3.2.31
	● IEC-bus Controller	PUC or PCA5	344.8900.14 375.2010.02	

3.2 Testing the Rated Specifications

3.2.1 Display, Keyboard and Spin Wheel

A self-test lasting approx. 4 s is carried out when the instrument is switched on. If no faults are registered during the self-test, the instrument reproduces the settings present before the last switch-off. An error code is displayed in the event of a fault.

All segments in the LCDs can be switched on for about 5 s using special function [D] [12] [SPEC] .

The illumination can be switched on and off using special function [11] [SPEC] . All LEDs can be switched on briefly using special function [D] [13] [SPEC] .

The spin wheel is applied to the analog display of the RF level field using special function [D] [14] [SPEC] . The analog bar is increased by rotating clockwise and decreased by rotating counterclockwise. One step corresponds to one analog bar segment. The special function [D] [15] [SPEC] can be called to test the keys. Each pressed key is then acknowledged in the alphanumeric display by a number associated with the key. The key and spin-wheel test can be terminated by pressing 0 in the numeric keypad.

3.2.2 Reference Frequency

Setting:

The connector REF 10 MHz 109 at the rear of the instrument is programmed as the output for the reference frequency of 10 MHz using special function [23] [SPEC] .

Test setup:

Connect a high-frequency meter to REF 10 MHz.

Test:

The error must not be more than:

$\pm 1 \times 10^{-6}$/month $\pm 1 \times 10^{-6}/^{\circ}C$ after 60 min warm-up time for the standard reference oscillator.
Adjust the frequency using R632 on the RF oscillator module.

1×10^{-9}/day after 15 min warm-up time for the crystal reference CMT-B1 (measured with frequency setting of 1 GHz at connector X1).
Adjust the frequency using PT1 on the RF oscillator module.

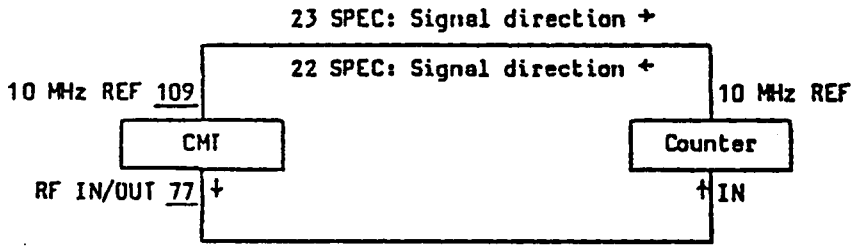
3.2.3 Frequency Setting and Accuracy

Setting (receiver test):

Output voltage 100 mV: [1] [0] [0] [mV] [Vo]

Switch off modulation: [0] [INT 1]

Test setup:



Test:

Set the following frequencies and check on the meter. The frequencies have been selected such that they can be exactly set despite an inherent setting error, so that the frequency meter exactly displays these frequencies to ±1 Hz.

Frequency (MHz)	Remarks
1000 830	] Top oscillator of top octave
820 660	] Centre oscillator of top octave
650 500	] Bottom oscillator of top octave
499.9	Range divided by 2
250	Range divided by 4
125	Range divided by 8
62.5	Range divided by 16
31	Mixed range
0.1	Lower limit

3.2.4 Setting Errors and Frequency Response of the RF Output Level

Setting (receiver test):

For FM:

Switch off frequency deviation: [0] [kHz] [INT1]

Output voltage 10 dBm: [1] [0] [dBm] [Vo]

For AM:

Switch off modulation depth: [0] [%] [INT1]

Output voltage -20 dBm: [-] [2] [0] [dBm] [Vo]

Test setup:

Connect power meter to RF IN/OUT 77.

Test:

Set frequencies between 0.1 and 1000 MHz.
The deviation from the correct value must be less than 0.7 dB.

Adjust the RF level using R514 on the output stage module.

3.2.5 RF Divider

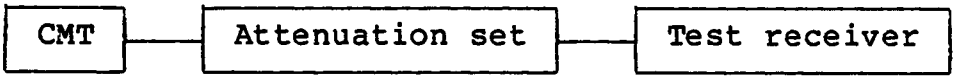
Setting (receiver test):

Frequency 32 MHz: [3] [2] [MHz] [f]

Initial level 10 dBm: [1] [0] [dBm] [Vo]

Switch off modulation: [0] [kHz] [INT1]

Test setup:



Test:

Set the test receiver to the 3-µV range and 32 MHz with 15 kHz bandwidth.

Carry out the following settings on the CMT and the attenuation set:

CMT level (dBm)	Attenuation of attenuation set (dB)	Tested RF attenuator (dB)	Permissible deviation (dB)
10	110	Reference	Reference
5	105	5	±0.2
0	100	10	±0.3
-5	95	5 with 10	±0.35
-10	90	20	±0.4
-30	70	2 x 20	±0.8
-50	50	40 with 20	±0.8
-90	10	2 x 40 with 20	±0.8

The test receiver indicates the same value with all settings with the deviations specified in the table referred to the 10-dBm setting.