Errata

Title & Document Type: **3746A Selective Level Measuring Set Operating Manual**

Manual Part Number: **03746-90003**

Revision Date: **January 1984**

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HP References in this Manual

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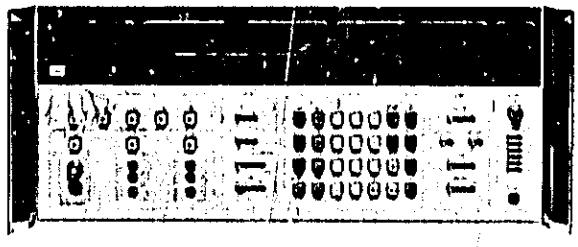
Agilent Technologies

HP3746A

OPERATING MANUAL

3746A

SELECTIVE LEVEL MEASURING SET



HEWLETT PACKARD

HP3746A

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

HEWLETT PACKARD

OPERATING MANUAL

3746A

SELECTIVE LEVEL MEASURING SET

(Including Options 001,005,011,012,014, 015 and 016)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 2403U. For additional important information about serial numbers see INSTRUMENTS COVERED BY MANUAL in Section 1.

Manual Part Number 03746-90003
Microfiche Part Number 03746-90028

Printed: Janu. y 1984

WARNING

READ THE FOLLOWING NOTES BEFORE INSTALLING OR SERVICING THE INSTRUMENT.

1. IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER MAKE SURE THAT THE COMMON TERMINAL OF THE AUTO-TRANSFORMER IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

2. THE INSTRUMENT MUST ONLY BE USED WITH THE MAINS CABLE PROVIDED. IF THIS IS NOT SUITABLE, CONTACT YOUR NEAREST HP SERVICE OFFICE. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

3. THE SERVICE INFORMATION FOUND IN THIS MANUAL IS OFTEN USED WITH POWER SUPPLIED TO AND PROTECTIVE COVERS REMOVED FROM THE INSTRUMENT. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

4. BEFORE SWITCHING ON THIS INSTRUMENT:

   (a) Make sure the instrument input voltage selector is set to the voltage of the power source.

   (b) Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

   (c) Ensure that the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient).

   (d) Check that the instrument fuse(s) is of the correct type and rating.

5. SERVICING INFORMATION:

   (a) This manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition. Service and adjustments should be performed only by qualified service personnel.

   (b) Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

   (c) Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

   (d) Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

LIST OF CONTENTS

SECTION I GENERAL INFORMATION

SECTION II INSTALLATION

SECTION III OPERATION

SECTION IV PERIPHERALS

SECTION V HEWLETT-PACKARD INTERFACE BUS

SECTION VI CONTROLS, CONNECTORS AND INDICATORS

SECTION VII APPENDICES

SECTION VIII MANUAL CHANGES

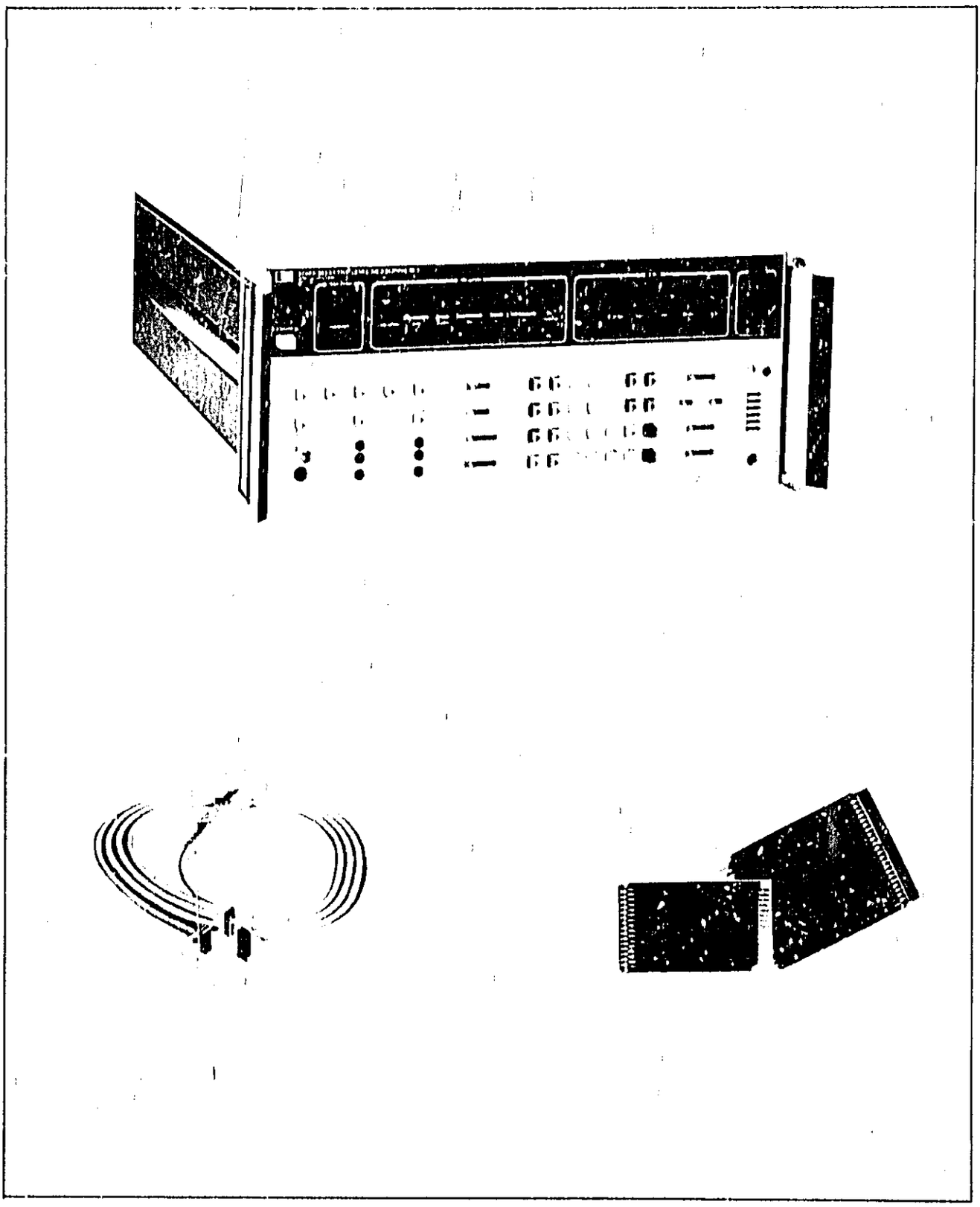


Figure 1-1 The 3746A Selective Level Measuring Set with Accessories Supplied

SECTION 1
GENERAL INFORMATION

1-1 INTRODUCTION

1-2 This operating manual contains information required to install and operate the Hewlett-Packard Model 3746A Selective Level Measuring Set (SLMS). The instrument together with the accessories supplied are shown in Figure 1-1.

1-3 Service information is contained in a separate Service Manual.

1-4 On the title page of this manual is a Microfiche Part Number. This number can be used to order 4 x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photo duplicates of the manual pages.

1-5 SPECIFICATION

1-6 Instrument specifications are listed in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested.

1-7 SAFETY CONSIDERATION

1-8 This product is a Safety Class B instrument (provided with a protective earth terminal). The instrument and manual should be reviewed for safety markings and instructions before operation. Also read the Warning on Page ii.

1-9 INSTRUMENTS COVERED BY MANUAL

1-10 Attached to the instrument is a serial number plate. This serial number is in the form XXXXUXXXXX. It is in two parts; the first four digits and the letter are the serial prefix and the last five are the suffix. The prefix is the same for all identical instruments, it changes only when a change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-11 An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this new instrument is accompanied by a Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-12 In addition to change information, the supplement may contain information for correcting errors in the manual.To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13 For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-14 DESCRIPTION

1-15 The Hewlett-Packard 3746A Selective Level Measuring Set (SLMS), is a high quality tunable power meter dedicated for use by operators and manufacturers of high density Frequency Division Multiplex (FDM) systems.

1-16 The SLMS has been specifically designed for manufacturers and operators conforming to both CCITT recommendations and for the North American Standards.

1-17 The SLMS is basically a tunable receiver, employing a synthesized local oscillator, controlled by a processor. A keyboard provides the interface between the operator and the processor.

1-18 The SLMS measures signal powers in the range 50Hz to 32MHz at levels between +20dBm and -115dBm, depending upon the measurement bandwidth used.

1-19 Either balanced or unbalanced measurements may be made.

1-20 Measured levels are true RMS values.

1-21 The instrument displays power levels either in dBm or in dB's relative to a dBm reference level. Automatic correction ensures that whichever input is selected the display will be correct for the chosen terminating impedance.

1-22 The frequencies at which measurements are required may be entered via the keyboard, either directly in kHz or as a description in a chosen FDM plan.

1-23 This ability to enter FDM descriptions directly into the instrument eliminates the need for FDM charts and line frequency tables to determine the frequencies to which the instrument is to be tuned.

1-24 Tuning to the measurement frequency is accomplished by mixing the received signal with a variable frequency signal from an internal synthesized local oscillator to give a fixed intermediate frequency. To achieve the high degree of selectivity and image rejection required, the SLMS uses multiple intermediate frequency (IF) stages.

1-25 The standard instrument is equipped with selective filters to allow a choice of measurement bandwidth.

1-26 The measurement of narrow bandwidth tones in a wideband measuring set requires extreme accuracy in the local oscillator frequencies used. This requirement is met by the use of a frequency synthesizer as the local oscillator in the SLMS. A master oscillator with a 10MHz crystal source, high spectral purity, and an aging rate of less than 1.5 x 10-8 parts per month is available as an option.

1-27 A processor provides overall control within the instrument, implementing routines which govern the measurement functions of the instrument and calculating from the various auto-ranging and analog to digital settings the levels to be displayed. The processor also determines the frequency and bandwidth setting required when FDM descriptions are entered.

1-28 The SLMS has a built-in control and drive circuitry which enables the SLMS to control up to 111 Access Switches.

1-29 The processor will accept instructions either from the operator via the keyboard or, if remote control of the instrument is required, through the Hewlett-Packard Interface Bus (HP-IB) connector on the rear panel. A degree of in-built intelligence in the processor enables it to detect if the instrument is required to perform an invalid measurement or if incorrect data is entered. In these circumstances a code number will appear in the TEST-POINT display window.

1-30 The processor performs a calibration of the measuring circuits at periodic intervals, substituting for the incoming signal an accurately defined signal derived from an internal high stability source. The processor stores the result of this measurement and uses any deviation from the expected measurement to modify the results of measurements made on external signals. Thus any inaccuracies resulting from thermal drift or aging in the measurement stages are greatly reduced.

1-31 OPTIONS

1-32 The following options are available with the SLMS and are covered by this manual:

Option 001 - Siemens series 2.5/6mm (75 ohm) connector substituted for the Unbalanced input connector.

Option 005 - Commercial equivalent of WECO 477B substituted for the Unbalanced and 124 ohm input connectors. Commercial equivalent of WECO 223A substituted for the 135 ohm and 600 ohm input connectors.

Option 011 - Group Filter

Option 012 - Tracking Generator

Option 014 - High Stability Oscillator

Option 015 - Channel Impairments - CCITT [phase jitter WTD Filter, Noise with Tone, Impulse Noise (single threshold)].

Option 016 - Channel Impairments - North America [phase jitter WTD Filter, Noise with Tone, Impulse Noise (single threshold)].

1-33 ACCESSORIES SUPPLIED

1-34 Figure 1-1 shows the HP Model 3746A together with the accessories supplied.

(a) The line power cable is supplied in one of six configurations depending upon the country of destination of the instrument (see Paragraph 2-11).

(b) The following manuals are supplied with each instrument.

1) Service Manual.....HP 03746-90000

2) Operating Manual.....HP 03746-90003

(C) Four extender boards H.P. Part No. 03746-60090 (2 off) and 03746-60091 (2 off) are supplied to extend PC boards during maintenance and repair procedures.

1-35 EQUIPMENT AVAILABLE

1-36 A 25MHz High-Impedance Active Probe (HP Model 15580A) is used in conjunction with the SLMS for bridging measurements. It has a 0dBm insertion Loss and a flatness of <+-0.2dB, over the frequency range 50kHz to 20MHz.

1-37 A 25MHz High-Impedance Passive Probe (HP Model 15581B) is used in conjunction with the SLMS for bridging measurements. It has a flatness of <+-0.2dB over the frequency range 50kHz to 20MHz, with a 20dB insertion Loss.

1-38 A Return Loss Kit (HP Model 15582A), in conjunction with a suitable Level Generator, allows the SLMS to make balanced and unbalanced return loss measurements over the frequency range 10kHz to 25MHz.

1-39 A Transit Case (9211-2650) with its custom mould inserts provides the SLMS with maximum protection during transit.

1-40 An Instrument Cart (Hp Model 15589A) carries the SLMS and its auxiliary equipment. Additional shelves can be supplied on request.

1-41 A Directional Bridge (HP Model 8721A OPT 008) with a suitable Level Generator allows the SLMS to make 75 ohm unbalanced return loss measurements over the frequency range 100kHz to 30MHz.

1-42 HP-IB Cables (HP Model 10833A/B/C/D) interface the SLMS with other HP-IB compatible instruments.

(The Hewlett-Packard Interface Bus (HP-IB) is Hewlett-Packard's implementation of IEEE Standard 488-1978.)

10833A	-	1 metres	(3.3 feet)
10833B	-	2 metres	(6.6 feet)
10833C	-	4 metres	(13.2 feet)
10833D	-	0.5 metres	(1.6 feet)

1-43 A Printer (HP Model 5150A OPT 001 or 2631B OPT 046) connected to the SLMS will provide a printed copy of measurement data such as frequency, level, FDM description and time of measurement. The SLMS can instruct the printer to print data for all, or any individual measurements or, if desired, record details of measurements which violate limits set by the operator.

1-44 An X-Y Display (HP Model 37461A) connected to the SLMS will provide a visual display of measurement data such as frequency and level measurements.

1-45 A tracking Frequency Synthesizer/Level Generator (HP Model 3335A or 3336A) is available and can be used in conjuction with the SLMS.

Table 1-1 Specifications

Except where otherwise indicated, the following parameters are warranted performance specifications. Parameters described as "typical" or "nominal" are supplemental characteristics which provide a useful indication of typical, but non-warranted, performance characteristics. Unless otherwise stated, all specifications are for 0° to 55°C after 30 minute warm-up.

FREQUENCY RANGE

Unbalanced Input (75Ω): 50 Hz to 32 MHz.
Balanced Inputs: 150Ω 10 kHz to 2 MHz
600Ω : 50 Hz to 100 kHz
124Ω (Option 005) : 10 kHz to 12 MHz
135Ω (Option 005) 10 kHz to 2 MHz
Minimum Frequency Step Size: 1 Hz.

FREQUENCY TUNING ACCURACY

INTERNAL STANDARD REFERENCE OSCILLATOR

Initial Setting Accuracy + Ageing over 1 year + Temperature Drift: $< \pm 5 \times 10^{-8}$.

OPTIONAL HIGH ACCURACY REFERENCE OSCILLATOR (Option 013)

Initial Setting Accuracy: $\pm 1 \times 10^{-7}$.
Ageing Rate: $< \pm 1.5 \times 10^{-7}$/Year.

WITH EXTERNAL REFERENCE OSCILLATOR

Frequency Error: error of external reference oscillator ± 1 Hz.

INTERNAL FREQUENCY COUNTER
(In addition to accuracy of Reference Oscillator)

Counter Accuracy: ± 1 Hz (38 Hz Filter, tone within 3 dB points) or ± 2 Hz (38 Hz, 3.1 kHz, Weighted and Notch Filters, tone within 55 dB points; 48 kHz Filter (Option 011), tone < 25 kHz from tuned frequency), for tone/measured interference ratio > 40 dB*.

* A variation of 0.2 dB pk-pk in the measured level of a tone within the 3 dB bandwidth of the 38 Hz filter at 0.1 dB resolution (AVE 1) would indicate a tone/interference ratio of 40 dB (nominal).

MEASUREMENT RANGES

UNBALANCED INPUT (75Ω)

Filter	Range	Noise Floor Including Spurious Products (with open circuit input)
38 Hz – Pilot	+20 to –115 dBm	< –105 dBm, 250 Hz to 50 kHz; < –115 dBm, 50 kHz to 32 MHz
3.1 kHz – Channel	+20 to –115 dBm	< –105 dBm, 10 kHz to 50 kHz; < –115 dBm, 50 kHz to 32 MHz
48 kHz – Group (Option 011)	+20 to –80 dBm	< –80 dBm, 100 kHz to 32 MHz
Broadband – Input Power	+20 to –55 dBm	< –55 dBm

BALANCED INPUTS†

Filter	Impedance	Range	Noise Floor Including Spurious Products (with open circuit input)
38 Hz – Pilot	124Ω, 135Ω, 150Ω	0 to –113 dBm	–113 dBm, 50 kHz to 10 MHz –113 dBm, 50 kHz to 2 MHz
3.1 kHz – Channel	124Ω, 135Ω, 150Ω	0 to –113 dBm	–113 dBm, 50 kHz to 2 MHz
	600Ω	0 to –80 dBm	–80 dBm, in basic channel (1.85 kHz)

† Standard input impedances: 600Ω and 150Ω; with Option 005: 600Ω, 124Ω and 135Ω.

INPUT CIRCUITS

UNBALANCED INPUT (75Ω)

Impedance	Return Loss 50 kHz to 32 MHz	Maximum ac Input Power	Maximum Continuous dc Voltage	Connector Type*
75Ω	> 30 dB	+25 dBm	± 0.5V	BNC

* Alternative connector types available – see OPTIONS.

Table 1-1 Specifications (continued)

BALANCED INPUTS†

Impedance	Return Loss	Common Mode Rejection Common Mode Signal ≤ 0 dBm	Maximum ac Input Power	Maximum Continuous dc Voltage	Maximum Longitudinal Voltage	Connector Type
124Ω	> 30 dB, 10 kHz to 12 MHz	> 40 dB, 10 kHz to 2 MHz > 35 dB, 2 MHz to 12 MHz	+26 dBm	± 3V	ac : 3V rms dc : 3V	Accepts WECO Plug 439A or 440A (Pair)
135Ω	> 30 dB, 10 kHz to 2 MHz	> 40 dB, 10 kHz to 2 MHz	+26 dBm	± 3V	ac : 3V rms dc : 3V	Accepts WECO Plug 241A (Pair)
150Ω	> 30 dB, 10 kHz to 2 MHz	> 40 dB, 10 kHz to 2 MHz	+26 dBm	± 3V	ac : 3V rms dc : 3V	Siemens Type 8 REL STP 6AC
600Ω	> 30 dB nominal, dc to 100 kHz	> 35 dB, dc to 100 kHz	+20 dBm	± 3V	ac : 3V rms dc : 3V	Standard: Siemens Type 8 REL STP 6AC Option 005: accepts WECO Plug 241A

† Standard input impedances: 600Ω and 150Ω; with Option 005: 600Ω, 124Ω and 135Ω.

MEASUREMENT ACCURACY

UNBALANCED INPUT (75Ω) – SELECTIVE MEASUREMENT (38 Hz AND 3.1 kHz FILTERS)

Frequency Range	Level Uncertainty over temperature range 10° to 35°C, after autocalibration (See Notes 1, 2, 4 and 5)	
	+20 to −60 dBm	−60 to −100 dBm (nominal)
38 Hz and 3.1 kHz Filters		
200 Hz to 10 kHz	≤ ± 1 dB (+20 to −70 dBm)	
10 kHz to 60 kHz	≤ ± 0.45 dB	≤ ± 0.65 dB
60 kHz to 20 MHz	≤ ± 0.25 dB	≤ ± 0.5 dB
20 MHz to 30 MHz	≤ ± 0.45 dB	≤ ± 0.7 dB

UNBALANCED INPUT (75Ω) – BROADBAND MEASUREMENT

Frequency Range	Level Uncertainty over temperature range 0° to 55°C, after autocalibration (See Note 3)
50 Hz to 32 MHz	≤ ± 1 dB, +20 to −45 dBm

UNBALANCED INPUT (75Ω) – GROUP POWER MEASUREMENT (48 kHz FILTER) OPTION 011

Frequency Range	Level Uncertainty over temperature range 0° to 55°C, after autocalibration (See Notes 3 and 5)
100 kHz to 32 MHz	≤ ± 1 dB, +20 to −75 dBm

Table 1-1 Specifications (continued)

BALANCED INPUTS† – SELECTIVE MEASUREMENT (38 Hz AND 3.1 kHz FILTERS)

Impedance	Frequency Range	Level Uncertainty over temperature range 10° to 35°C, after autocalibration (See Notes 1, 2, 4 and 6)	
		0 to −60 dBm	−60 to −100 dBm (nominal)
124Ω	10 kHz to 60 kHz	< ± 0.5 dB	< ± 0.7 dB
	60 kHz to 12 MHz	< ± 0.3 dB	< ± 0.5 dB
135Ω	10 kHz to 60 kHz	< ± 0.5 dB	< ± 0.7 dB
	60 kHz to 2 MHz	< ± 0.3 dB	< ± 0.5 dB
150Ω	10 kHz to 60 kHz	< ± 0.5 dB	< ± 0.7 dB
	60 kHz to 2 MHz	< ± 0.3 dB	< ± 0.5 dB
600Ω	200 Hz to 100 kHz	< ± 1 dB (0 to −70 dBm)	

BALANCED INPUTS† – GROUP POWER MEASUREMENT (46 kHz FILTER) OPTION 011

Impedance	Frequency Range	Level Uncertainty over temperature range 0° to 55°C, after autocalibration (See Notes 3 and 6)
124Ω	100 kHz to 12 MHz	< ± 1 dB, 0 to −75 dBm
135Ω	100 kHz to 2 MHz	< ± 1 dB, 0 to −75 dBm
150Ω	100 kHz to 2 MHz	< ± 1 dB, 0 to −75 dBm

BALANCED INPUTS† – BROADBAND MEASUREMENT

Impedance	Frequency Range	Level Uncertainty over temperature range 0° to 55°C, after autocalibration (See Note 3)
124Ω	10 kHz to 12 MHz	< ± 1 dB, 0 to −45 dBm
135Ω	10 kHz to 2 MHz	< ± 1 dB, 0 to −45 dBm
150Ω	10 kHz to 2 MHz	< ± 1 dB, 0 to −45 dBm
600Ω	200 Hz to 100 kHz	< ± 1 dB, 0 to −45 dBm

† Standard input impedances: 600Ω and 150Ω; with Option 005: 600Ω, 124Ω and 135Ω.

NOTE 1 To extend temperature range for 0° to 55°C operation, add ± 0.1 dB for all selective measurements in the frequency range 10 kHz to 32 MHz.

NOTE 2 Accuracy specified is for 0.01 dB display resolution. For 0.1 dB resolution, add ± 0.08 dB. For 1 dB resolution, add ± 1.5 dB (nominal).

NOTE 3 Accuracy specified is for 0.1 dB display resolution. For 1 dB resolution, add ± 1.5 dB (nominal).

NOTE 4 Accuracy specified is for single input signal within defined level range.

NOTE 5 Accuracy specified assumes that 3746A is tuned to signal frequency ± 1 Hz.

MEASUREMENT DISPLAY

Resolution: 0.01 dB with Averaging 2 (38 Hz and 3.1 kHz filters only)
0.1 dB with Averaging 1
1 dB with Averaging 0.

FILTERS

PILOT FILTER – 38 Hz

Ripple over 22 Hz Bandwidth: < 0.1 dB pk-pk.
3 dB Bandwidth: 38 Hz, ± 10%
Adjacent Pilot Rejection (± 60 Hz): > 38 dB
Rejection at > ± 110 Hz: > 60 dB.
Rejection at > ± 2 kHz: > 80 dB
Equivalent Noise Bandwidth: 44 Hz (nominal).

Table 1-1 Specifications (continued)

CHANNEL FILTER – 3.1 kHz

Ripple over 2.6 kHz Bandwidth: < 0.5 dB pk-pk.
3 dB Bandwidth: 3.1 kHz, ± 10%
Virtual Carrier Rejection at ± 1.85 kHz: > 65 dB
Adjacent Channel Rejection (± 4 kHz): > 70 dB.
Equivalent Noise Bandwidth: 3.1 kHz (nominal).

GROUP FILTER – 48 kHz (OPTION 011)

Ripple over 35 kHz: < 1.2 dB pk-pk.
3 dB Bandwidth: 48 kHz, ± 12%
Adjacent Group Rejection (± 48 kHz): > 26 dB
Rejection at > ± 60 kHz: > 40 dB
Equivalent Noise Bandwidth: 52 kHz (nominal)

NOMINAL MEASUREMENT TIMES

	0.01 dB Resolution		0.1 dB Resolution		1 dB Resolution
	3 dB Separation*	60 dB Separation	3 dB Separation*	60 dB Separation*	
Pilot Filter	< 1260 ms	< 1600 ms	< 460 ms	< 800 ms	< 500 ms
Channel Filter	< 640 ms	< 1130 ms	< 140 ms	< 330 ms	< 140 ms
Group Filter (Option 011)	–	–	< 200 ms	< 300 ms	< 200 ms

* "Separation" is the difference in level (in dB) between adjacent measurements.

INTERMODULATION AND SPURIOUS PRODUCTS

Second Order Intermodulation Rejection: > 63 dB (relative to the total power of two input signals and measured at $|f_1 \pm f_2|$ where this is in band).
Third Order Intermodulation Rejection: > 70 dB (for two tones greater than 60 kHz apart), > 60 dB (for two tones less than 60 kHz apart), relative to the total power of two input signals and measured at $|2f_1 \pm f_2|$ and $|2f_2 \pm f_1|$ where these are in band.

NOMINAL INTERMODULATION PERFORMANCE

Unbalanced Input: On a fully loaded 1800 channel system with a mean channel level of -15 dBm0, the SLMS intrinsic NPR is > 68 dB for all autoranging states.

IMAGE AND IF REJECTION

Description	Frequency	Rejection
½ x 1st IF	25.0078125 MHz	> 60 dB
1st IF (Channel & Pilot Filters)	50.015625 MHz	> 70 dB
1st IF Image	*	> 70 dB
2nd IF (Channel & Pilot Filters)	15625 Hz	> 70 dB
2nd IF Image	**	> 75 dB
3rd IF (Pilot Filter)	919 Hz	> 80 dB
3rd IF Image	***	> 65 dB

* 1st IF Image = Tuned Frequency + (2 x 1st IF) (Channel and Pilot Filters only)

** 2nd IF Image = Tuned Frequency + (2 x 2nd IF) (Channel and Pilot Filters only)

*** 3rd IF Image = Tuned Frequency + (2 x 3rd IF) (Pilot Filter only)

ADDITIONAL INPUTS/OUTPUTS

10 MHz REFERENCE INPUT

Frequency Required to Maintain Lock: 10 MHz, or any integer sub-multiple of 10 MHz, in range 1 to 10 MHz.
Level: -3 dBm to +20 dBm into 50Ω.

Accuracy and Stability: dependent on External Source.
Connector: BNC 50Ω.

10 MHz REFERENCE OUTPUT

Frequency: 10 MHz.
Initial Setting Accuracy + **Ageing Rate** + **Temperature Drift** } **Total Error:** < ± 6 x 10^{-8}
Level: +6 dBm ± 2 dB into 50Ω, or -30 dBm ± 2 dB into 75Ω, dependent on setting of internal link.

Table 1-1 Specifications (continued)

10 MHz OVEN OUTPUT (OPTION 013)

Frequency: 10 MHz.
Initial Setting Accuracy: $\pm 1 \times 10^{-7}$.
Ageing Rate: $< \pm 1.5 \times 10^{-7}$/year.
Level (when oven has reached operating temperature) 0 dBm (nominal) into 50Ω.
Connector: BNC 50Ω.

AUDIO OUTPUTS (REAR PANEL)

Provide demodulated voice channel output when 3.1 kHz Filter is selected. Specifications only apply if 0.1 dB or 0.01 dB Resolution operative. An output is also available when Weighted & Notch Filters (provided by Options 015 and 016) are selected, but specifications relating to frequency response and level no longer apply.
Frequency Response: ± 1 dB (600 Hz to 3.1 kHz).
Nominal Impedance: 600Ω balanced.
Nominal Level (after autoranging): −3 dBm to −13 dBm
Connector: Siemens type 9 REL STP 6AC (3-pin) and Jack Socket compatible with WECO 347 or ¼" Jack Plug

AUDIO OUTPUT (FRONT PANEL)

Provides amplified version of rear panel Audio Output to internal loudspeaker or audio jack.
Level: 0 dBm maximum into 600Ω, adjustable by volume control.
Connector: compatible with WECO 347 or ¼" Jack Plug

PROBE POWER

Voltages: + 15.5V and − 12V.
Current: 100 mA maximum (both voltage lines).
Connectors: compatible with Hewlett-Packard standard Probe Power Jack.

ACCESS SWITCH CONTROLLER

Provides control signals for HP 3764A, 3766A and/or 3767A Access Switches. Provides dc power sufficient for one 3767A Access Switch.
Number of Selectable Signal Ports: 10 with a single Access Switch, up to 1000 with 111 cascaded Access Switches.
Switch Control Path: 2-wire (only) to first level Access Switch. 2-wire or coaxial from first level Access Switch to second and third level switches.
Acceptable dc Resistance of 2-wire Path (between 3746A and first level Access Switch, or between Switches) 100Ω.
Nominal Connect/Disconnect Times using 3764A Access Switch(es):
Connection Time (N = Switch Port Number):
0.9 + (N x 0.05)s/switch, or
0.03 + (N x 0.002)s/switch with Rear Panel "Access Switch Speed" selector set to Normal or Fast respectively.
Input Termination Disconnect Time: 0.5 ms.

Digital Control Signals:
Nominal Pulse Rate: 20 pulses/s ± 15% or 600 pulses/s ± 15%, depending on setting of rear panel switch (Normal or Fast, respectively).
Nominal Mark : Space Ratio: 50 : 50 ± 20%.
Power Supply Output (for 3767A Access Switch)
Voltages: +15.5V ± 1V
−15.5V ± 1V
Current: 100 mA maximum (+ and −).
Connector: 6-screw terminal block (Power Supply and 2-wire output).

PHASE JITTER OUTPUT

Provides access to the sidebands on a 1 kHz tone as selected by Phase Jitter measurement.
Connector: BNC.

CHART RECORDER/METER DRIVE OUTPUT
(activated by special key sequence)

Provides two types of output drive – current or voltage – suitable for connection to an external Chart Recorder or Meter. Changeover between current and voltage drive is by means of internal switches.
Current Drive:
Output: 0 to +5 mA, proportional to measured level of SLMS input signal (after centering within dynamic range).
Dynamic Range: ± 3 dB.
Maximum Load Impedance: 1200Ω.
Voltage Drive:
Output: −3 to +3V dc, proportional to measured level of SLMS input signal (after centering within dynamic range).
Dynamic Range: ± 3 dB.
Nominal Output Impedance: 1000Ω.
Connectors: pair of Binding Posts (Banana Sockets) on 1" (25.4 mm) centres.

HP-IB INTERFACE

Loading: 1 Bus Load, capable of driving up to 14 HP-IB devices.
Interface Functions Subset:
3746A as Controller: SH1 AH1 T4 L4 SR0 RL0 PP0 DC0 DT0 C1 C3 C4 C28.
3746A under remote control: SH1 AH1 T6 L4 SR1 RL1 PP0 DC1 DT1 C0.
Compatible Peripherals (Bus Controllable from SLMS)
Tracking Frequency Synthesizers: HP Models 3330B, 3335A and 3336A/B.
Printers: HP Models 82905A, 5150A, 2631B and other HP-IB Printers.
CRT Display: HP Model 37461A.
Standard HP-IB Addresses (decimal)
3746A: 10.
HP-IB Extender: 17.
CRT Display: 03
Printer: 05.
Synthesizer: 04.

Table 1-1 Specifications (continued)

GENERAL

Dimensions:
Height: 180 mm (7.5 in)
Width: 460 mm (18.1 in)
Depth: 496 mm (19.6 in)
(Overall — including handles, feet and connectors)
Weight:
Net: 25 kg (56 lb)
Shipping: 34 kg (75 lb)
Power:
Voltages: 100/120/220/240V
Tolerance: +6%, −10%
Frequency: 48 to 66 Hz
Power Consumption: 200 VA (max).

OPTIONS

CONNECTOR OPTIONS (FRONT PANEL ONLY)

OPTION 001

75Ω Unbalanced Input Connector: Siemens Series 1.6/5.6 mm.

OPTION 005

75Ω Unbalanced Input Connector: commercial equivalent of WECO Type 477B (accepts WECO Plug 358A).
124Ω Balanced Input Connectors (pair) commercial equivalent of WECO Type 477B on 16 mm (0.625 in) centres (accepts WECO Plug 358A).
135Ω Balanced Input Connectors (pair) commercial equivalent of WECO Type 223A on 16 mm (0.625 in) centres (accepts WECO Plug 241A)
600Ω Balanced Input Connectors: commercial equivalent of WECO Type 223A (accepts WECO Plug 241A).

MEASUREMENT OPTIONS

OPTION 011 – GROUP FILTER

Allows the 3746A to measure power in a 12 channel Group over 48 kHz bandwidth (−3 dB points). Full specification of Group Filter, including measurement range, accuracy and filter shape is provided in the main 3746A Specifications. The Group Filter Option also provides a Supergroup power measurement capability; the SLMS can automatically evaluate and display Supergroup power as the logarithmic sum of 5 Group power measurements.

OPTION 012 – TRACKING GENERATOR

Provides an integral Tracking Generator with output frequency the same as SLMS tuned frequency. Disabled when 48 kHz or Weighted Filters are selected.
Level: 10 dBm ± 0.5 dB (nominal).
Flatness: ± 0.2 dB, 10 kHz to 32 MHz.
Spurious and Harmonic Signals Relative to Main Output: < −40 dB.
Connector: BNC 75Ω.
Return Loss: > 30 dB, 10 kHz to 32 MHz.

OPTION 013 – HIGH STABILITY FREQUENCY REFERENCE

Increases SLMS tuning accuracy.
Initial Setting Accuracy: $\pm 1 \times 10^{-7}$
Ageing Rate: $< \pm 1.5 \times 10^{-7}$/year.

OPTION 015 – CHANNEL IMPAIRMENTS (CCITT)

Provides a psophometrically weighted filter with selectable 1010 Hz notch, and measurement of Phase Jitter, and Impulse Noise.

WEIGHTED FILTER

Psophometric weighting superimposed on 3.1 kHz Channel Filter, in accordance with CCITT Recommendation P.53 A (Geneva 1980).
Uncertainty of Weighted Noise Measurement: < ± 1 dB.
Measurement Resolution: 1 dB or 0.1 dB.

PHASE JITTER

Measurement of Phase Jitter is performed on a demodulated 1 kHz Channel Test Tone.
Frequency of Demodulated Tone: 1 kHz ± 50 Hz
Measurement Bandwidth: selectable 4 Hz to 20 Hz, 20 Hz to 300 Hz or 4 Hz to 300 Hz
Residual Phase Jitter: < 0.6° pk-pk.
Accuracy: ± 10% ± 0.5°.

NOTCH FILTER

Adds a 1010 Hz Notch to Weighted Filter response in accordance with CCITT Recommendation O.132.

IMPULSE NOISE

Provides a single threshold Impulse Noise measurement in accordance with CCITT Recommendation 0.71.
Maximum Measurement Period: 99 minutes 59 seconds.
Maximum Impulse Count: 999.
Counting Rate: 125 ms/count ± 5%.
Threshold Accuracy on 1700 Hz Tone: ± 1 dB for threshold ≥ −60 dBm, and ≤ + 20 dBm. Measured channel power should not exceed threshold by more than 54 dB.

Table 1-1 Specifications (continued)

OPTION 016 – CHANNEL IMPAIRMENTS (NORTH AMERICA)

Provides a C-message weighted filter with selectable 1010 Hz notch, and measurement of Phase Jitter and Impulse Noise.

WEIGHTED FILTER

C-Message weighting superimposed on 3.1 kHz Channel Filter as specified in BSTR Pub. 41009.
Uncertainty of Weighted Noise Measurement: < ± 1 dB.
Measurement Resolution: 1 dB or 0.1 dB.

PHASE JITTER

Measurement of Phase Jitter is performed on a demodulated 1 kHz Channel Test Tone.
Frequency of Demodulated Tone: 1 kHz ± 50 Hz.
Measurement Bandwidth: selectable 4 Hz to 20 Hz, 20 Hz to 300 Hz or 4 Hz to 300 Hz.
Residual Phase Jitter: ≤ 0.5° pk-pk.
Accuracy: ± 15% ± 0.5°.

NOTCH FILTER

Adds a 1010 Hz Notch to Weighted Filter response in accordance with BSTR Pub. 41009.
Rejection: > 50 dB, 995 Hz to 1025 Hz.
< 3 dB at 862 Hz and 1182 Hz.
Out of Band Ripple (< 400 Hz and > 1700 Hz): < ± 0.5 dB.

IMPULSE NOISE

Provides a single threshold Impulse Noise measurement in accordance with BSTR Pub. 41009
Maximum Measurement Period: 99 minutes 59 seconds.
Maximum Impulse Count: 999.
Counting Rate: 143 ms/count ± 6%.
Threshold Accuracy on 1700 Hz tone: ± 1 dB for threshold ≥ −60 dBm, and ≤ +20 dBm. Measured channel power should not exceed threshold by more than 64 dB.

OPTION 907 - FRONT HANDLE KIT

Adds front handles to the SLMS.

OPTION 908 – RACK FLANGE KIT

Enables the SLMS to be secured in a 483 mm (19 in) rack.

OPTION 909 – RACK AND HANDLE KIT

Combination of Options 907 and 908.

OPTION 910 – EXTRA SET OF MANUALS

INSTALLATION

SECTION II
INSTALLATION

2-1 INTRODUCTION

2-2 This section provides installation instructions for the Hewlett-Packard Model 3746A Selective Level Measuring Set (SLMS) and its accessories. This section also includes information about initial inspection and damage claims, preparation for using SLMS and packaging, storage and shipment.

2-3 INITIAL INSPECTION

WARNING

TO AVOID HAZARDOUS ELECTRICAL SHOCK, DO NOT PERFORM ELECTRICAL TESTS WHEN THERE ARE SIGNS OF SHIPPING DAMAGE TO ANY PORTION OF THE OUTER ENCLOSURE (COVERS, PANELS, METERS).

2-4 Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1; procedures for checking electrical performance are given in Section IV of the Service Manual. If the contents are incomplete, if there is mechanical damage or defect or if the SLMS does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carriers inspection. The HP office will arrange for repair or replacement at HP Option without waiting for claim settlement.

2-5 PREPARATION FOR USE

WARNING

TO AVOID THE POSSIBILITY OF INJURY OR DEATH, THE FOLLOWING PRECAUTIONS MUST BE FOLLOWED BEFORE THE INSTRUMENT IS SWITCHED ON.

(A) NOTE THAT THE PROTECTION PROVIDED BY GROUNDING THE INSTRUMENT CABINET MAY BE LOST IF ANY POWER CABLE OTHER THAN THE THREE-PRONGED TYPE SUPPLIED IS USED TO COUPLE THE AC LINE VOLTAGE TO THE INSTRUMENT.

(B) IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTO-TRANSFORMER TO REDUCE OR INCREASE THE LINE VOLTAGE, MAKE SURE THAT THE COMMON TERMINAL IS CONNECTED TO THE NEUTRAL POLE OF THE POWER SOURCE.

(C) THE POWER CABLE PLUG SHALL ONLY BE INSERTED INTO A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

2-6 Power Requirements

2-7 The SLMS requires a power source of 100V, 120V, 220V, or 240V ac, +5%-10%, 48 to 66Hz single phase. The maximum power consumption is 200VA.

2-8 Line Voltage Selection and Fuse

2-9 The line voltage is selected by the rear panel switch labelled 100V, 120V, 220V and 240V.

CAUTION

Before connecting the instrument to a power outlet ensure that the line voltage selector is correctly set, and that a fuse of the correct rating is fitted.

2-10 Fuse ratings are given in Table 2-1.

Table 2-1 Fuses

Nominal Line	Fuse Rating	HP Part Number
100V 120V	2A	2110-0002
220V 240V	1A	2110-0001

2-11. Power Cable

2-12 This instrument is equipped with a three-wire power cable. When connected to a power outlet, this cable grounds the instrument case. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 2-1 for part numbers of the power cable and plug configurations available. The number shown below each plug is the Hewlett-Packard part number of a power cord equipped with that plug. If the appropriate power cord is not included with the instrument, notify the nearest Hewlett-Packard Sales and Service Office and a replacement will be provided.

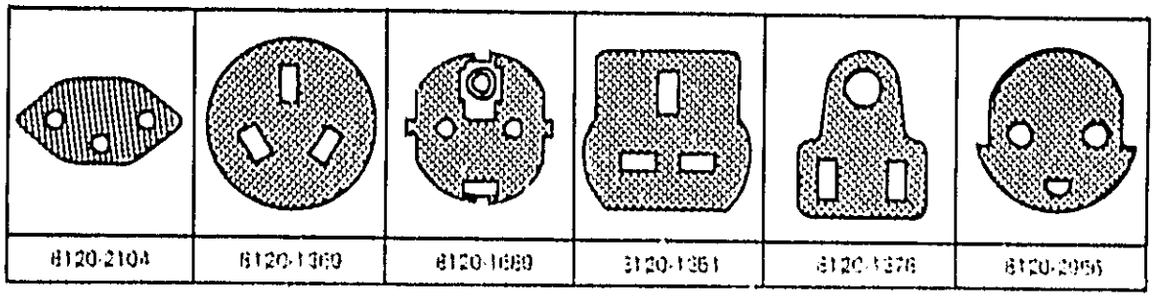


Figure 2-1 Power Receptacles

2-13 The colour code used in each power cable is given below:

Line	Brown
Neutral	Blue
Ground	Green/Yellow

2-14 Operating Environment

2-15 Temperature —— The instrument may be operated in temperatures from 0 degrees centigrade to +55 degrees centigrade.

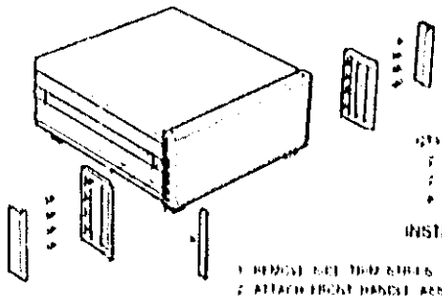
2-16 Humidity —— The instrument should be protected from temperature extremes which may cause condensation within the instrument.

2-17 Altitude —— The instrument may be operated at altitudes up to 4600m (15,000ft).

2-18 RACK MOUNTING

2-19 Illustrated in Figure 2-2 are the three Rack Mount Kits available with the SLMS.

7H FRONT HANDLE KIT
[PRODUCT HT 177.0mm (6.969 in)]
HP PART NUMBER 5061-0080 (option 907)



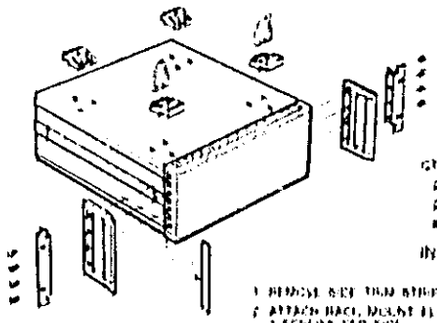
CONTENTS

QTY		PART NO
2	FRONT HANDLE ASS'Y	[illegible]
2	FRONT HANDLE TRIM	[illegible]
4	[illegible] SCREWS	[illegible]

INSTRUCTIONS

1. [illegible]
2. ATTACH FRONT HANDLE ASS'Y WITH 4 SCREWS PER SIDE
3. [illegible]

7H RACK MOUNT KIT WITH FRONT HANDLES
[PRODUCT HT 177.0mm (6.969 in)]
HP PART NUMBER 5061-0084 (option 908)



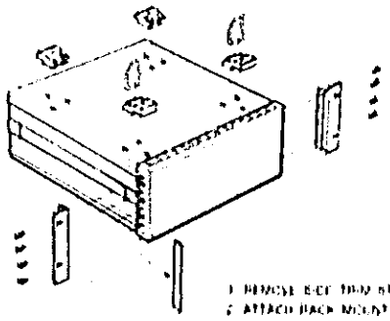
CONTENTS

QTY		PART NO
2	RACK MOUNT FLANGE	[illegible]
2	FRONT HANDLE ASS'Y	[illegible]
8	[illegible] SCREWS	[illegible]

INSTRUCTIONS

1. [illegible]
2. ATTACH RACK MOUNT FLANGE AND FRONT HANDLE ASS'Y WITH 4 SCREWS PER SIDE
3. REMOVE FEET AND TILT STANDS BEFORE RACK MOUNTING

7H RACK MOUNT KIT WITHOUT FRONT HANDLES
[PRODUCT HT 177.0mm (6.969 in)]
HP PART NUMBER 5061-0078 (option 909)



CONTENTS

QTY		PART NO
2	RACK MOUNT FLANGE	[illegible]
8	[illegible] SCREWS	[illegible]

INSTRUCTIONS

1. [illegible]
2. ATTACH RACK MOUNT FLANGE WITH 4 SCREWS PER SIDE
3. REMOVE FEET AND TILT STANDS BEFORE RACK MOUNTING

Figure 2-2 Rack Mount Kits

2-20 STORAGE AND SHIPMENT

2-21 Environment

2-22 The instrument may be stored or shipped in environments within the following limits:

Temperature.....-40 degrees centigrade to
+75 degress centigrade
Altitude.....15,300M (50,000ft)

2-23 The instrument should also be protected from temperature extremes which may cause condensation within the instrument.

2-24 Packaging

2-25 Tagging for Service —— If the instrument is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the front of this manual and attach it to the instrument.

2-26 Original Packaging —— Containers and material identical to those used in the factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container 'FRAGILE' to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-27 Other Packaging —— The following general instructions should be used for re-packing with commercially available materials:

(a) Wrap instrument in heavy paper or plastic. (If shipping to Hewlett-Packard office or service centre, attach a tag indicating type of service required, return address, model number and full serial number.)

(b) Use strong shipping container. A double-walled carton made of 350-pound test material is adequate.

(c) Use a layer of shock absorbing material 70 to 100mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Ensure the control panel is protected with cardboard or some other suitable material.

(d) Seal shipping container securely.

(e) Mark the shipping container 'FRAGILE' to ensure careful handling.

(f) In any correspondence, refer to instrument by model number and full serial number.

2-28 ALTERNATIVE OUTPUTS

2-29 The rear panel 10MHz OUTPUT and CHART RECORDER OUTPUT both have two selectable output modes which are determined by the setting of test links and switches within the 3746A. The folowing paragraphs outline the procedures for converting these outputs.

WARNING

THE FOLLOWING PROCEDURES SHOULD BE PERFORMED BY SERVICE TRAINED PERSONNEL WHO ARE AWARE OF THE HAZARDS INVOLVED.

2-30 10MHz OUTPUT (+6dBm, 50 ohm or −30dBm, 75 ohm)

2-31 The 3746A is normally supplied with the rear panel 10MHz OUTPUT in the +6dBm, 50 ohm mode. The following procedure modifies the output to −30dBm, 75 ohm.

PROCEDURE

1. Disconnect the power cable.
2. Remove the 3746A top cover.
3. Remove Assembly A40 from housing.
4. Remove A40TL1 from '50' position and fit it to '75' position.
5. Replace items in steps 1,2 and 3 (in the reverse order) to restore the 3746A ready for use.

2-32 CHART RECORDER OUTPUT (voltage or current drive)

2-33 The 3746A is normally shipped with the rear panel CHART RECORDER OUTPUT in the voltage drive mode. The following procedure modifies the output to current drive.

PROCEDURE

1. Disconnect the power cable.
2. Remove the 3746A top cover.
3. Remove Assemblies A21 and A60 from housings.
4. Remove A21TL1 from 'V' position and fit it into 'I' position.
5. Switch A60S2 switch position 1 to ON (or '1' position).
6. Replace items in steps 1,2 and 3 (in the reverse order) to restore the 3746A ready for use.

2-34 EXTENDING THE CCITT FDM PLANS

2-35 The SLMS CCITT FDM plans 1A and 2 are extended to 4 Super Master Groups and 4 Hypergroups respectively by carrying out the following procedure.

WARNING

BEFORE CARRYING OUT THE FOLLOWING PROCEDURE ENSURE THAT THE MAINS POWER CABLE IS DISCONNECTED FROM THE INSTRUMENT.

PROCEDURE

1. Remove the top cover.
2. Remove Assembly A60.
3. Switch A60S2(7) to the '0' position (see Figure 2-3).
4. Replace Assembly A60 and the top cover.
5. Set the front panel PLAN switch to CCITT (1A or 2 as required) and the MASTER GPS/SYSTEM BW switch to 12MHz position.

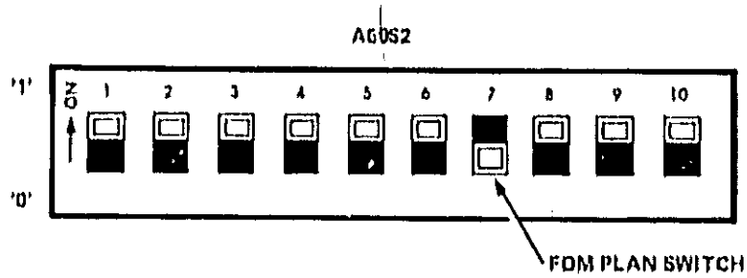


Figure 2-3 Extending FDM Plan

2-36 HEWLETT-PACKARD INTERFACE (HP-IB) BUS INSTALLATION

2-37 This section contains information and instructions on the installation of the 3746A Selective Level Measurement Set (SLMS) into a Hewlett-Packard Interface Bus (HP-IB) system.

2-38 The HP-IB is Hewlett-Packards implementation of the IEEE Standard 488-1978 (Digital Interface for Programmable Instrumentation). This standard defines a physical interface and protocol which enables the remote control of instrumentation systems.

2-39 CONNECTION TO THE HP-IB

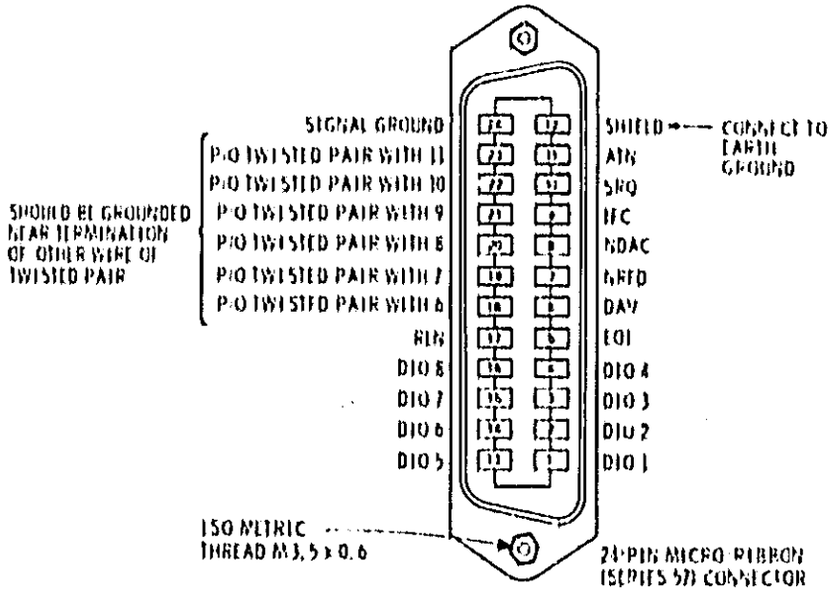


Figure 2-4 HP-IB (rear panel) Connector

2-40 The HP-IB connector on the rear panel of the SLMS provides the physical interface to connect the SLMS into an HP-IB system. Figure 2-4 illustrates the connector pin configuration. Devices in the HP-IB system may be interconnected in any suitable arrangement (star, delta, etc) using the HP-IB cables listed in Table 2-2 provided the restrictions given in Paragraph 2-41 are obeyed.

Table 2-2 HP-IB Interface Cables

HP-IB Part Numbers	Cable Lengths
HP10833A	1m (3.3ft)
HP10833B	2m (6.6ft)
HP10833C	4m (13.2ft)
HP10833D	0.5m (1.6ft)

2-41 To achieve design performance, restrictions are placed on the length of HP-IB system cable as follows:

1. The total length of HP-IB cable used to interconnect devices on the HP-IB must not exceed 2 metres (6 feet) times the number of devices in the system.

2. The total length of HP-IB cable used to interconnect all devices must not exceed 20 metres (65 feet).

2-42 SLMS CONFIGURATION

2-43 The SLMS may be configured either as the system controller in an HP-IB system containing certain selected peripherals or as a device under the remote control of a separate system controller (normally a computer or computing controller). Seperate installation information is given as described below depending upon whether the SLMS is configured as the system controller or as a device under the control of a separate system controller. Paragraphs 2-44 to 2-51 describe SLMS installation in an HP-IB system where the SLMS is configured as the system controller. Paragraphs 2-52 to 2-56 describe SLMS installation in an HP-I system where the SLMS is configured as a device under the control of a separate system controller.

2-44 SLMS CONFIGURED AS SYSTEM CONTROLLER

2-45 The setting of the CNTRL switch (see Figure 2-5) on the SLMS rear panel to the CNTRL ON (1) position configures the SLMS as the system controller.

2-46 As the system controller the SLMS has the ability to control the operation of suitable Printers, Frequency Synthesizers, HP-IB Bus Extenders and CRT Displays. A list of suitable HP equipment is given in Table 2-3.

Table 2-3 SLMS As Controller – Suitable HP Equipment

Device	HP Model
Printer	HP 5150A Opt 001 (20 column) HP 2631B Opt 046 (80 column)
Frequency Synthesizer	HP 3330B (0.1-13MHz) HP 3335A (200Hz-80MHz) HP 3336A/B/C (10Hz-21MHz)
CRT Display	HP 37461A CRT Display
HP-IB Bus Extender	HP 37201A Bus Extender

2-47 HP-IB DEVICE ADDRESSING

2-48 Each device in an HP-IB system requires a unique address to distinguish it from other devices in the system. An SLMS configured as the system controller has fixed listen and talk addresses as detailed in Table 2-4. Other devices on the HP-IB system must be set to respond to the appropriate address as listed in Table 2-4. Refer to the individual instrument operating manual for details on address setting.

Table 2-4 Device Addresses

Device	Listen Address		Talk Address	
	Decimal	ASCII Char	Decimal	ASCII Char
SLMS (Fixed)	42	*	74	J
Printer	05	%	–	–
Synthesizer	04	$	–	–
CRT Display	03	#	–	–
HP-IB Extender	49	1	81	Q

2-49 REAR PANEL HP-IB SWITCHES

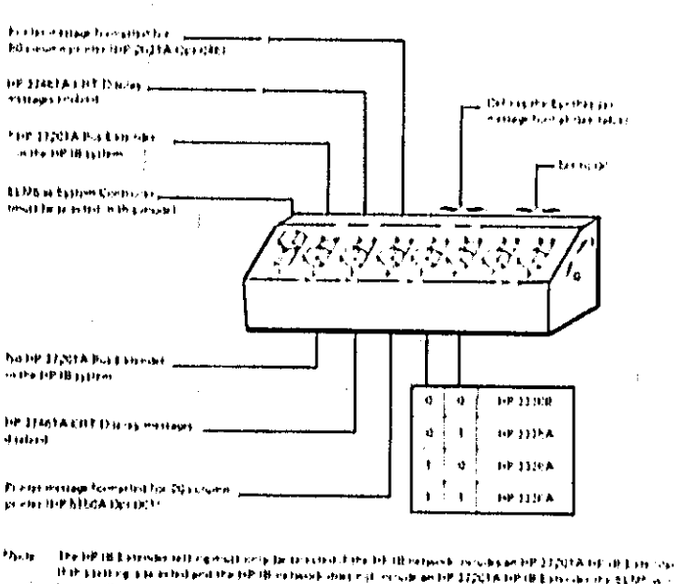


Figure 2-5 HP-IB Switch Settings – SLMS as System Controller

2-50 With the SLMS configured as the system controller, the switch settings on the rear panel HP-IB switch bank inform the SLMS which

message format is required for the particular devices connected into the HP-IB. The switch settings are explained and illustrated in Figure 2-5. For detailed descriptions of the message formats transmitted by the SLMS see Section V.

2-51 SLMS CONFIGURED AS DEVICE

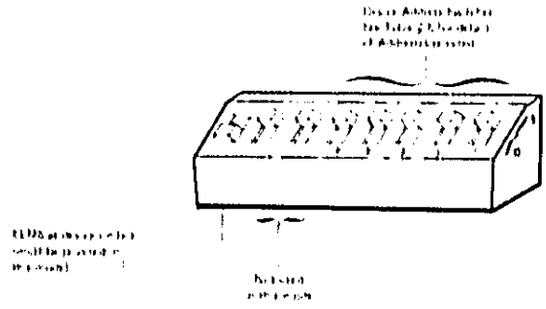


Figure 2-6 HP-IB Switches – SLMS as Device on Bus

2-52 The settings of the CNTRL switch (see Figure 2-6) on the SLMS rear panel to the CNTRL OFF (0) position configures the SLMS as an HP-IB device under the remote control of a separate HP-IB controller.

2-53 HP-IB ADDRESSING

2-54 Each device in the HP-IB system requires a unique address to enable the system controller to differentiate between devices. The SLMS has one listen address and three talk addresses. The addresses are defined by the setting of the Device Address switches within the HP-IB switch bank on the SLMS rear panel. The setting of these switches and the corresponding listen and talk addresses are illustrated in Figure 2-6 and Table 2-5 respectively. Note that the device address switch must not be set between 29 and 31 inclusive since this will cause invalid addresses.

2-55 Care should be taken to enusre that the listen or talk addresses of any other device in the HP-IB system does not duplicate one of the SLMS listen or talk addresses.

Table 2-5 SLMS Address Setting

Device Address					Device Address	Listen Address			Talk Addresses								
						Octal	Decimal	ASCII	Octal			Decimal			ASCII		
16	8	4	2	1					1	2	3	1	2	3	1	2	3
0	0	0	0	0	0	40	32	Space	100	101	102	64	65	66	@	A	B
0	0	0	0	1	1	41	33	!	101	102	103	65	66	67	A	B	C
0	0	0	1	0	2	42	34	"	102	103	104	66	67	68	B	C	D
0	0	0	1	1	3	43	35	#	103	104	105	67	68	69	C	D	E
0	0	1	0	0	4	44	36	$	104	105	106	68	69	70	D	E	F
0	0	1	0	1	5	45	37	%	105	106	107	69	70	71	E	F	G
0	0	1	1	0	6	46	38	&	106	107	110	70	71	72	F	G	H
0	0	1	1	1	7	47	39	'	107	110	111	71	72	73	G	H	I
0	1	0	0	0	8	50	40	(	110	111	112	72	73	74	H	I	J
0	1	0	0	1	9	51	41	)	111	112	113	73	74	75	I	J	K
0	1	0	1	0	10	52	42	*	112	113	114	74	75	76	J	K	L
0	1	0	1	1	11	53	43	+	113	114	115	75	76	77	K	L	M
0	1	1	0	0	12	54	44	,	114	115	116	76	77	78	L	M	N
0	1	1	0	1	13	55	45	-	115	116	117	77	78	79	M	N	O
0	1	1	1	0	14	56	46	.	116	117	120	78	79	80	N	O	P
0	1	1	1	1	15	57	47	/	117	120	121	79	80	81	O	P	Q
1	0	0	0	0	16	60	48	0	120	121	122	80	81	82	P	Q	R
1	0	0	0	1	17	61	49	1	121	122	123	81	82	83	Q	R	S
1	0	0	1	0	18	62	50	2	122	123	124	82	83	84	R	S	T
1	0	0	1	1	19	63	51	3	123	124	125	83	84	85	S	T	U
1	0	1	0	0	20	64	52	4	124	125	126	84	85	86	T	U	V
1	0	1	0	1	21	65	53	5	125	126	127	85	86	87	U	V	W
1	0	1	1	0	22	66	54	6	126	127	130	86	87	88	V	W	X
1	0	1	1	1	23	67	55	7	127	130	131	87	88	89	W	X	Y
1	1	0	0	0	24	70	56	8	130	131	132	88	89	90	X	Y	Z
1	1	0	0	1	25	71	57	9	131	132	133	89	90	91	Y	Z	[
1	1	0	1	0	26	72	58	:	132	133	134	90	91	92	Z	[	\
1	1	0	1	1	27	73	59	;	132	134	135	91	92	93	[	\	]
1	1	1	0	0	28	74	60	<	134	135	136	92	93	94	\	]	^
1	1	1	0	1	29	DO NOT USE THESE ADDRESSES											
1	1	1	1	0	30												
1	1	1	1	1	31												

OPERATION

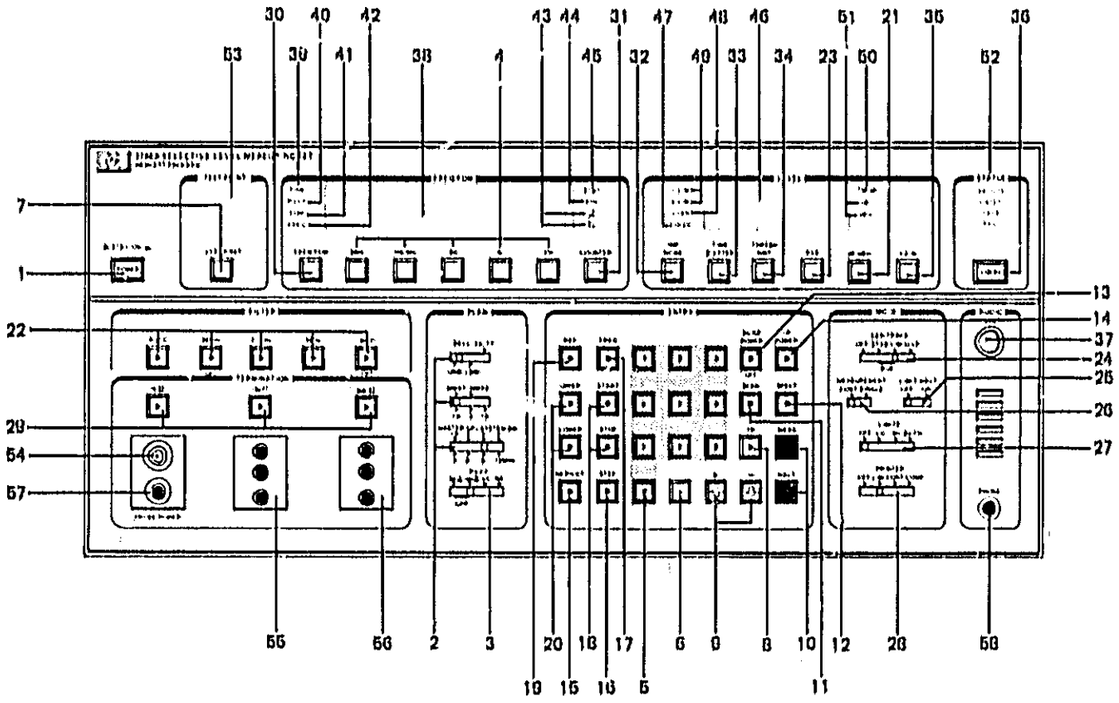


Figure 3-1 SLMS Front Panel

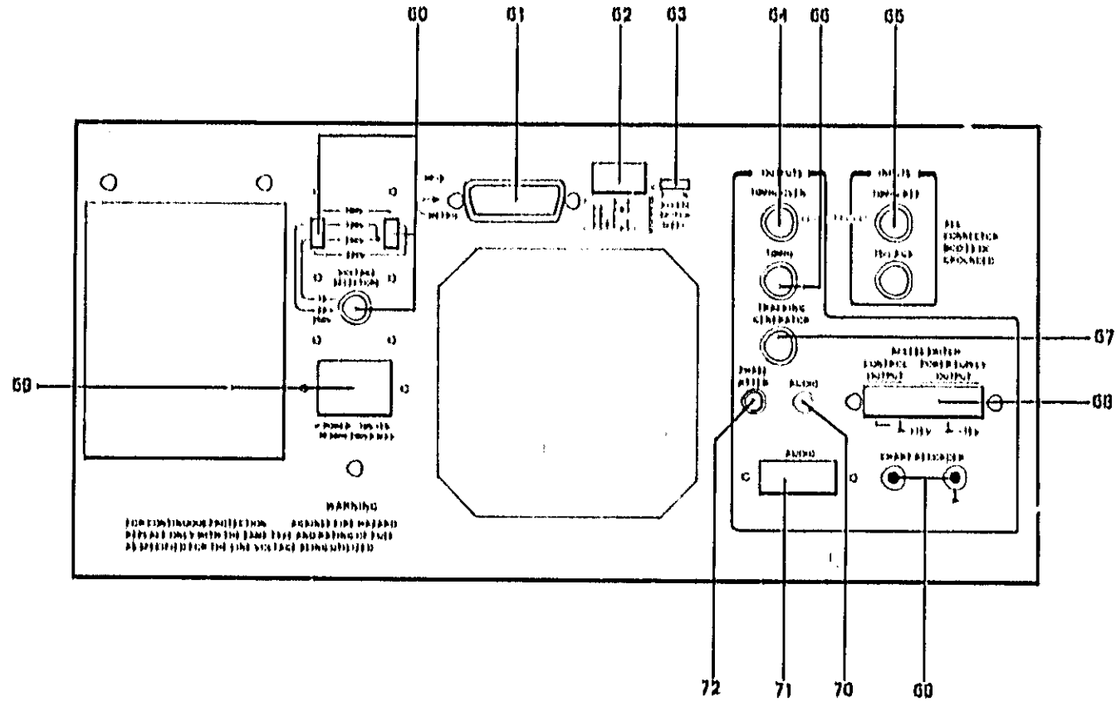


Figure 3-2 SLMS Back Panel

SECTION III

OPERATION

3-1 INTRODUCTION

3-2 This section describes and gives examples of some of the measurements that can be made with the 3746A Selective Level Measuring Set. A description of the function of each control is given in Section VI. Any Frequency Division Multiplex (FDM) examples given in this section apply to an MMX-2C (L4) system for operators working to North American (BELL) standards and to Plan 1B, 12MHz, 2700 channel system for those operators conforming to CCITT standards.

3-3 OPERATORS CHECK

3-4 The following procedure will give a reasonable indication to an operator that the 3746A is functioning normally.

1. Set the 3746A POWER switch to the STBY position, then set to ON. This procedure activates a reset sequence. All the display and switch indicators should be on and remain on for a few seconds.

2. The 3746A should now be initialised with the 75 ohm TERMINATION, AUTO and 3.1kHz FILTER selected. The instrument will be in the HALT mode and will have a number displayed in the FREQ/FDM display. This is the frequency (recovered from the non volatile memory) to which the instrument was last tuned.

3. Press the [AVE] then [2] key to give the 3746A a level resolution of 0.01dB. As the instrument is in the HALT mode nothing will appear to happen.

4. Set all slide switches to their left hand position.

5. Press the [FREQ] key and enter a frequency of 10000.00kHz using the numeric keys.

6. Press the [MEAS] key. The instrument should execute the CAL cycle (indicated by the word CAL appearing in the Level Display). The 3746A should then continuously monitor the signal level at the input. In the absence of an input signal the level displayed will be the noise floor of the instrument and should be <-115dBm.

7. Connect the Rear Panel 10MHz OUTPUT to the Front Panel 75 ohm INPUT. The 3746A Level Display should now indicate the level of the 10MHz OUTPUT.

8. Enter a Start Frequency of 50kHz, Stop Frequency of 32MHz and a step size of 10kHz using the following key sequences.

[START] [FREQ] [5] [0]
[STOP] [FREQ] [3] [2] [0] [0] [0]
[STEP] [1] [0]

Press [SPECT] [MEAS]. The Frequency Display should start at 50kHz and increment in steps of 10kHz towards 32MHz. If the instrument is fitted with the group filter option the 48kHz FILTER will be selected, otherwise the 3.1kHz FILTER will remain selected.

9. Press [HALT] at any time to Halt the measurement.

3-5 If the 3746A is fitted with option 013 High Stability Oscillator and the instrument is switched on from cold the OVEN annunciator will be illuminated indicating that the crystal oven used in the High Stability Oscillator has not reached its full operating temperature. Until the OVEN annunciator is extinguished the 3746A will not achieve its full tuning specifications.

3-6 FRONT AND REAR PANEL CONTROLS

3-7 Figures 3-1 and 3-2 identify all front and rear panel controls, connectors and indicators. The number associated with each control, connector or indicator refers to the number opposite its description in Section VI.

3-8 REFERENCE SETTINGS

3-9 For all measurements detailed in this section the following switch settings will give valid results, unless otherwise specified.

ALL INSTRUMENTS (CCITT and BELL)

FILTER	AUTO
AVERAGING	Press [AVE] [1]
GEN TRACK	OFF
MEASUREMENT	CONT
LIMIT HALT	OFF
LIMITS	OFF
PRINTER	OFF
TERMINATION	75 OHM

FOR BELL EXAMPLES

U600/L600	U600
MMX1/MMX2	MMX2
MASTER GPS	6
PILOT	104Δ

FOR CCITT EXAMPLES

BELL/CCITT	CCITT
1A/2/1B	1B
SYSTEM BW	12MHz
PILOT	84Δ

3-10 INPUT CONNECTORS

3-11 A choice of input impedances is available as detailed below:

150 Ohm balanced	Siemens 3 pin plug
600 Ohm balanced	Siemens 3 pin plug

3-12 The input connectors detailed above are those fitted to the standard instrument. When an option which affects the connectors is fitted the connectors will change as detailed below:

Option 001	Siemens series 2.5/6mm (75 Ohm) connector substituted for the 75 Ohm BNC unbalanced input connector.
Option 005	Input impedances of 75 Ohm (unbal), 124 Ohm, 135 Ohm and 600 Ohm (bal). Commercial equivalent of WECO Type 477B used for 75 Ohm and 124 Ohm inputs and Type 223A for 135 Ohm and 600 Ohm inputs.

Note: Measurement frequency range varies with the different inputs - see Table of Specifications in Section I.

3-13 Active and passive high impedance probes are available as accessories (see Section I) and permit bridging measurements to be made.

3-14 The input connections to the 3746A should be made through shielded cables equipped with the appropriate connector. The cables should be as short as possible, to minimise extraneous pick-up.

Note: Connections should not be made to more than one input, or input pair, simultaneously.

3-15 INPUT OVERLOADING

3-16 If the total input power to the 3746A exceeds approximately +20dBm on the unbalanced input or 0dBm on the balanced input, Overload (OLOAD) will appear in the FREQ/FDM Display and steps must be taken to reduce the received power level, since this may cause overloading of the input circuits.

CAUTION

If the total input power exceeds +25dBm damage may result.

3-17 ERROR CODES

3-18 If the user tries to make an invalid measurement, or incorrect data is entered via the keyboard, then 'E' and a number will appear in the Test-Point Display indicating an Error. The significance of each Error Code is explained in Section VII.

3-19 ENTERING MEASUREMENT PARAMETERS

3-20 In the majority of cases pressing a key when the 3746A is in the Measurement mode will cause the instrument to revert to the Halt mode. This prevents parameters being changed during a measurement, which could give misleading or erroneous results.

3-21 LEVEL DISPLAY

3-22 The Level Display indicates the true rms power, in the selected filter bandwidth, centered on the frequency shown in the Frequency Display. The level displayed is either absolute power in dBm or power in dB's relative to a previously entered reference level. The dB and dBm annunciators indicate the units in which the level measurement is displayed. To change from dBm to dB, or Vice Versa, press the [dB/dBm] key.

Note: If Options 015 or 016 are fitted then the Level Display will be used to display other parameters as described later in this section.

3-23 REFERENCE LEVEL

3-24 The level to which dB measurements are referenced are entered by pressing the [REF] key and entering the required level in dBm, using the numeric keys. The reference level may be either +ve or -ve and will always be in dBm. When the [REF] key is pressed the current reference level will be displayed in the Level Display.

EXAMPLE: Enter a reference level of -19.35dBm

Press [REF] [-] [1] [9] [.] [3] [5]

Level Display: -19.35

3-25 dBm0 MEASUREMENTS

3-26 If the reference level is set to correspond to the Relative Transmission Level at the point of measurement, then the Level Display readings can be considered as being dBm0 when the dB annunciator is illuminated.

3-27 dB RELATIVE TO 1mW IN 600Ω

3-28 In some countries it is common practice to relate all level measurements to a standard 1mW in 600 Ohm, even when the circuit impedance is 75 Ohm. The readings from the 3746A may be related directly to this standard by entering a Reference Level of -9.03dBm. Readings expressed in dB will then be relative to 1mW in 600 Ohm, ie, relative to 0.775V. The correction factor -9.03 corresponds to 10 log 75/600.

3-29 AVERAGING

3-30 Three averaging modes are available which affect the time taken for each measurement and thus the resolution of the Level Display. The averaging modes are selected as follows:

Press [AVE] [0] ..... Display resolution 1dB
Press [AVE] [1] ..... Display resolution 0.1dB
Press [AVE] [2] ..... Display resolution 0.01dB

Note: Changing the averaging when the 3746A is in the Measurement mode will initiate a calibration sequence indicated by CAL appearing in the Level Display. If the 3746A is in the Halt mode when the averaging is changed, the calibration sequence will be initiated when the [MEAS] key is pressed.

If the 40kHz or WTD Filter is selected or if the 3746A is performing an Input Power measurement then the Level Display will only indicate to 0.1dB even when [AVE] [2] has been selected.

3-31 TOTAL INPUT POWER MEASUREMENT

3-32 To display the total input power, press [I/P POWER] - all displays will blank. Now press [MEAS] and the total input power will be continually monitored and displayed in the Level Display.

3-33 MEASUREMENT BY FREQUENCY DESCRIPTION

3-33 (a) Tuning to a Particular Frequency

3-34 The 3746A will tune with a 1Hz resolution to any frequency within its measurement range (50Hz to 32MHz). To tune to a particular frequency, press [FREQ] - the last frequency to which the 3746A was tuned will appear in the FREQ/FDM Display - followed by the required frequency in kHz using the numeric keys. Press [MEAS] and the 3746A will tune to the selected frequency and continuously measure and display the input level at that frequency.

EXAMPLE: Tune to 13289.531kHz

Set the switches to the reference settings (see paragraph 3-8).

Press [FREQ] [1] [3] [2] [8] [9] [.] [5] [3] [1]
Press [MEAS]
FREQ/FDM Display - 13289.531kHz
Level Display - Signal Power

3-35 MANUAL TUNING

3-36 When the 3746A has been tuned to a frequency by the [FREQ] key and is in the Measurement mode, pressing either [↑] or [↓] will initially Halt the measurement; subsequent [↑] or [↓] keystrokes will respectively increase or decrease the frequency to which the instrument is tuned, by an amount equal to the content of the Step Size Register and make a single level measurement at each frequency. If either key is held down, then the frequency to which the 3746A is tuned will step continuously in the specified direction.

3-37 An entry is made to the Step Size Register by pressing [STEP] and using the numeric keys to specify the required frequency increment in kHz. The minimum permissible step size is 1Hz (0.001kHz).

3-38 SPECTRUM

3-39 In a Spectrum measurement a sequence of level measurements is carried out, in equal steps, between specified frequency limits. These frequency limits and the frequency step, are specified by the contents of the Start Frequency, Stop Frequency and Step Size Registers. Entries to the Start and Stop Registers are made by pressing either [START] [FREQ] or [STOP] [FREQ] and using the numeric keys to specify the parameter in kHz. Entries to the Step Size Register are made by pressing the [STEP] key only, followed by the numeric keys. When [START] [FREQ], [STOP] [FREQ], or [STEP] is pressed the content of the corresponding register appears in the FREQ/FDM Display.

Note: The stop frequency must always be greater than the start frequency for a spectrum measurement.

When [SPECT] [MEAS] is pressed the 3746A will step between the start and stop frequencies by the frequency held in the Step Size Register, making a level measurement at each step.

EXAMPLE: Carry out a continuous Spectrum measurement between 9000kHz and 9500kHz using a 10kHz step.

Set the switches to the reference settings (see paragraph 3-8).

Press [START] [FREQ] [9] [0] [C] [0]
Press [STOP] [FREQ] [9] [5] [0] [0]

Press [STEP] [1] [0]
Press [SPECT] [MEAS]

3-40 At any time during a Spectrum measurement the [↑] or [↓] keys may be pressed to Halt the sweep. Subsequent [↑] or [↓] keystrokes will step the frequency manually. Each time [↑] or [↓] is pressed a single measurement of the level at the new frequency will be made and displayed. If [MEAS] is pressed again, the sweep will continue from the frequency shown in the FREQ/FDM Display but may sweep up or down depending on whether the [↑] or [↓] key was the last one pressed.

3-41 During a Spectrum measurement the [AUTO] Filter will select where possible, a filter whose bandwidth is greater than the step size (see Table 3-1).

Table 3-1 Auto Filter Selection (Spectrum)

Step Size	Filter
1Hz to 10Hz	30Hz
11Hz to 2.999kHz	3.1kHz
3kHz and above	40kHz*

*Option 011 only

Any filter can be manually selected by pressing the appropriate key. If a different filter is selected in the middle of a spectrum sweep, the instrument will revert to the Halt mode. To start the sweep again press [SPECT] [MEAS]. A new calibration cycle will be initiated (CAL appears in the Level Display) before the sweep continues. Another use of the [SPECT] mode is for High level Search, which is described in paragraph 3-173.

3-42 STORED RANDOM FREQUENCIES

3-43 When measurements are to be made at frequencies not related by a fixed increment or by an FDM structure, then up to 145 separate frequencies can be stored in the 3746A Random Frequency Register.

3-44 To gain access to the Random Frequency Register press [TR] [1] [1]. The number 001 should appear in the TEST-POINT Display which is used in this function as a register pointer. If position 001 has not had a frequency entered previously then 0.000kHz should appear in the FREQ/FDM Display. To enter a frequency use the numeric and decimal point keys to specify the frequency in kHz. Press the [↑] key to move the pointer to the next location and enter another frequency. Up to 145 frequencies may be stored in this way (if the register pointer is increased to 146 the word "End" will appear in the FREQ/FDM Display indicating that the maximum number of frequencies has been entered). The Register Pointer can be moved up and down at any time using the [↑] and [↓] keys.

Note: If at any time an error is made while entering a frequency, press [CLEAR/SET] and respecify the frequency.

3-45 Any number of frequencies (N) may be stored up to the maximum of 145. To restrict the sequence to N frequencies, increase the Register Point to N+1 after the Nth frequency is entered and press [CLEAR/SET] - "End" will appear in the FREQ/FDM Display. Pressing [SPECT] [NS PILOT] [MEAS] will sweep the 3746A through the frequencies held in the Random Frequency Register up to Register Pointer N. The sweep can be halted at any time by pressing the [HALT] key and the [↑] and [↓] keys can then be used to manually step through the stored frequencies.

EXAMPLE: Store the following five frequencies in the Random Frequency Register and sweep through them continuously:

10kHz, 11.95kHz, 12.1kHz, 15kHz, 16.5kHz

Press [TR] [1] [1]
Press [1] [0]
Press [↑] [1] [1] [.] [9] [5]
Press [↑] [1] [2] [.] [1]
Press [↑] [1] [5]
Press [↑] [1] [6] [.] [5]
Press [↑] [CLEAR/SET]
Press [SPECT] [NS PILOT] [MEAS]

3-46 FREQUENCY COUNTER/AFC

3-47 The 3746A can measure the frequency of the incoming signal and retune to that frequency, provided it is within certain limits of the frequency to which the 3746A is currently tuned. These limits vary with the filter selected.

Note: For full counter specifications see Table of Specifications in Section I.

EXAMPLE: Suppose a pilot is expected to be at 9.99995MHz but has drifted off frequency, the 3746A can measure the pilot frequency and retune to that frequency as shown below.

Set the switches to their reference settings (see paragraph 3-8).

Connect the rear panel 10MHz output to the front panel 75 Ohm input and select the 30Hz FILTER.

Press [FREQ] [9] [9] [9] [9] [.] [9] [5] [MEAS]

The 3746A Level Display will be reading approximately -60dBm indicating that the pilot is not at the correct frequency.

Press [COUNTER] [MEAS]

The FREQ/FDM Display should read 10000.000kHz +-2Hz - Note the 3746A is only measuring the input frequency and has not retuned. To retune the 3746A to the input frequency,

Press [TR] [COUNTER] [MEAS]

The 3746A will retune to the input signal (10000.000kHz) and display the measured level in the Level Display.

3-48 MEASUREMENT BY FDM DESCRIPTION

3-48 (a) TUNING FROM AN FDM DESCRIPTION

3-49 Before attempting to tune within an FDM plan, the type of plan in use must first be specified using the three switches under PLAN. Section VII contains information to help identify the particular plan in use and also gives the required switch settings for each plan.

3-50 The PILOT switch must be set to the frequency of the basic group pilot and should not be in the NS (Non-Standard) or VC (Virtual Carrier) positions unless a specific measurement is being made which requires their selection. The use of the NS and VC positions is covered later in this section.

Note: It is important to ensure there are no unwanted, previously entered FDM skips. See paragraph 3-80.

3-51 MEASUREMENT BANDWIDTH IN FDM SYSTEMS

3-52 If the FILTER selection is in the AUTO position, then the 3746A will automatically select a filter according to Table 3-2.

Table 3-2 Automatic Filter Selection (FDM)

FDM Measurement	Filter
Channel †	3.1kHz
Pilot	38Hz
Group Power*	48kHz

*Option 011 only
†Pilot switch not in VC or NS position

3-53 FDM DISPLAY

3-54 The FDM Display indicates the point in the FDM system to which the 3746A is tuned. FDM and Frequency information share the same display (FREQ/FDM) which can be toggled between frequency and FDM information by the [FREQ/FDM] key.

3-55 The current content of the FDM Display can be altered by pressing any of the FDM description keys twice (a '-' will appear in the display) and entering the required number for that level using the numeric keys. The other FDM levels can be changed in the same manner except the description key for each level need only be pressed once. FDM descriptions can be entered in any order.

3-56 If the measurement mode is changed to the Frequency mode the content of the FDM Display is retained in memory and can be recalled by pressing any of the FDM description keys once.

3-57 FDM DESCRIPTION

3-58 The 3746A may be connected at any stage of the FDM hierarchy from a basic channel up to line level. When connected to a chosen point, measurements may be made at all the levels of the FDM hierarchy below that point. For example, when connected to a basic supergroup the 3746A can measure any group or channel within the basic supergroup. Only group and possibly channel numbers (depending on the measurement being made) are required and the positions for supergroup and higher levels must be left at zero.

EXAMPLE: Tune to channel 4 in the basic group.

Set the switches to the reference settings (see paragraph 3-8).

Press [Any FDM key] - to bring forward the FDM Display
Press [HG/MG] [0] [SG] [0] [G] [0] [CH] [4]
Press [MEAS]

Level Display - Signal level in channel
FDM Display - Channel 4 of the basic group
Press [FREQ/FDM]
Frequency Display - 94.150kHz

EXAMPLE: Tune to channel 4 of group 5 in the basic supergroup.
Set the switches to the reference settings (see paragraph 3-8).

Press [Any FDM key] - to bring forward the FDM Display
Press [HG/MG] [0] [SG] [0] [G] [5] [CH] [4]
Press [MEAS]

Level Display - Signal level in channel
FDM Display - Group 5, Channel 4 of the basic supergroup
Press [FREQ/FDM]
Frequency Display - 577.850kHz

3-59 CHANNEL MEASUREMENT

3-60 When a channel measurement is made using the 3.1kHz Filter, as in the previous examples, the filter will select the exact audio band in the channel as shown in Figure 3-3. Since the Frequency Display always indicates the centre frequency of a chosen filter, then it will in this case indicate the frequency to which the centre of this audio band (1850Hz) would be translated at the indicated point in the FDM hierarchy.

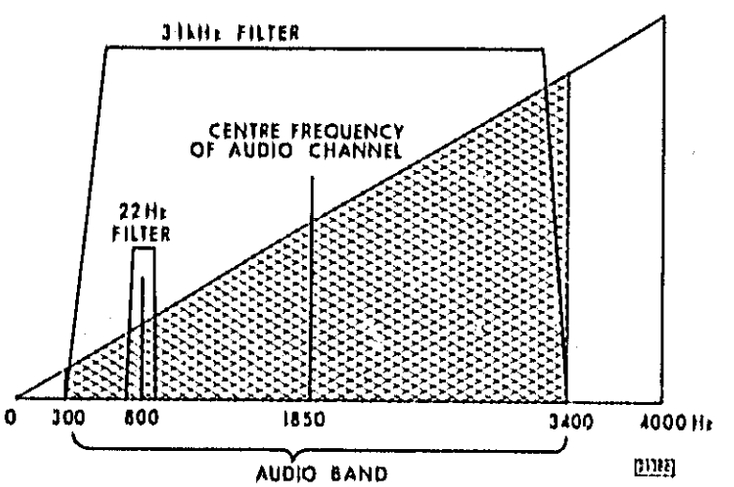


Figure 3-3 A Basic Voice Channel

3-61 TUNING TO THE 800Hz OR 1kHz CHANNEL TEST TONE

3-62 If the 3BHz Filter is selected when a channel is specified, the 3746A will no longer tune to the centre of the audio band, but instead will tune to the frequency that an 800Hz (1kHz for Bell) test tone would occupy in the selected channel and the 3BHz Filter will be centred on this point. It is possible to tune to any other test frequency in a channel by using the [NS PILOT] key as explained later in this section.

3-63 PILOT FREQUENCIES

3-64 The 3746A can be tuned to pilots as well as channels, by means of an FDM description. However, before correct pilot frequencies can be extracted from the stored FDM plan information, the PILOT switch must be set to define the frequency of the basic reference pilots. Two standard settings are provided for the basic group reference pilot, 84Δ (84.08kHz) and 104Δ (104.08kHz). In either of these positions, the frequencies of the other basic reference pilots are as follows:

BELL		CCITT	
Basic Supergroup	315.92kHz	Basic Supergroup (104Δ)	547.920kHz
Basic Supermastergroup	2840kHz	Basic Supergroup (84Δ)	411.92kHz
		Basic Master/Hypergroup	1552kHz
		Basic Supermastergroup	11096kHz

3-65 If basic reference pilots at different frequencies are required, the PILOT switch should be set to Non-Standard (NS) and the appropriate frequency entered into the Non-Standard Pilot Register using the [NS PILOT] and numeric keys (see paragraph 3-87). Having defined the reference pilot in the basic group, supergroup, etc. the 3746A will calculate the corresponding pilot frequency at any stage in the multiplex.

3-66 PILOT MEASUREMENTS

3-67 A pilot measurement is defined by omitting the channel number from an FDM description. If a channel number is not specified then the 3746A will tune to the pilot of the lowest defined level in the FDM description.

EXAMPLE (CCITT): Tune to group 4 pilot, of supergroup 5, of mastergroup 8, of supermastergroup 2.

Set the switches to the reference settings (see paragraph 3-8).

Press [CH] - to bring forward the FDM Display
Press [CH] [0] [G] [4] [SG] [5] [MG/MG] [8] [SMG] [2]
Press [FREQ/FDM] [MEAS]
Level Display - Group pilot level
Frequency Display - 5972.080kHz

EXAMPLE (BELL): Tune to group 4 pilot, of supergroup 15, of mastergroup 6.

Set the switches to the reference settings (see paragraph 3-8).

Press [CH] - to bring forward the FDM Display
Press [CH] [0] [G] [4] [SG] [15] [MG] [6]
Press [FREQ/FDM] [MEAS]
Level Display - Group Pilot level
Frequency Display - 16959.92kHz

3-6B MEASUREMENT OF BASIC REFERENCE PILOTS

3-69 To measure the basic pilot associated with the FDM level at which the 3746A is connected simply enter a '-' in the display at that level and enter 0 for all others.

EXAMPLE: With the 3746A connected to a basic group point, measure the level of the basic group pilot.

Set the switches to the reference settings (paragraph 3-8).

Press [CH] - to bring forward the FDM display
Press [CH] [0] [SG] [0] [MG/MG] [0] [SMG]* [0]* [G]
Press [FREQ/FDM] [MEAS]
*CCITT Plans only

Frequency Display - 104.08kHz (BELL), 84.08kHz (CCITT)
Level Display - Basic Group Pilot Level

3-70 GROUP AND SUPERGROUP POWER MEASUREMENTS

3-71 Group and Supergroup power measurements are only available on instruments fitted with Option 011. Measurements are made by entering the FDM description of the group or supergroup to be measured then pressing the [SG/GP POWER] [MEAS] keys. The group or supergroup power will be continuously monitored and displayed.

EXAMPLE (BELL): Measure the group power in group 4, of supergroup 13, of mastergroup 1.

Set the switches to the reference settings (paragraph 3-8).

Press [G] - to bring forward the FDM display
Press [G] [4] [SG] [13] [MG/MG] [1]
Press [SG/GP POWER] [FREQ/FDM] [MEAS]

Frequency Display - 636.000kHz
Level Display - Continuously updated group power measurement

EXAMPLE (CCITT): Measure the group power in group 4, of supergroup 5, of mastergroup 7, of supermastergroup 2.

Set the switches to the reference settings (see paragraph 3-8).

Press [G] - to bring forward the FDM display
Press [G] [4] [SG] [5] [MG/MG] [7] [SMG] [2]
Press [SG/GP POWER] [FREQ/FDM] [MEAS]

Frequency Display - 7292.000kHz
Level Display - Continuously updated group power measurement

3-72 Supergroup powers can be measured in the same way by setting the FDM entry in the group position to zero. The supergroup power measurement uses the 48kHz group power filter and averages the result over five measurements.

3-73 Basic group and supergroup power levels can be monitored by setting all the FDM entry levels to zero except group or supergroup (whichever is required) which should be left as a dash "-". Pressing [SG/GP POWER] [MEAS] will then continuously monitor the basic group or supergroup power level.

EXAMPLE: Monitor the level in the basic supergroup.

Press [CH] - to bring forward the FDM display
Press [CH] [0] [SMG]* [HG/MG] [SG] - a '-' should be in the SG position.

*CCITT only

Press [SG/GP POWER] [FREQ/FDM] [MEAS]

Frequency Display - 432.000kHz
Level Display - Continuously updated basic supergroup power level

3-74 SCAN

3-75 In a scan a sequence of level measurements is carried out while incrementing through the FDM hierarchy. The scan begins at the point in the FDM plan indicated by the FDM display and proceeds in steps of the lowest specified FDM entry. Thus, if the lowest FDM entry is a channel, then channels will be scanned. If group is the lowest FDM entry specified, then either group pilots or group powers will be scanned, depending upon whether or not [SG/GP POWER] was pressed. Similarly supergroup powers or pilots will be scanned if the lowest FDM entry specified is a supergroup. When the number of the lowest specified FDM level has reached its maximum value it will revert to its minimum value and the next FDM level up if present will be incremented. This process is repeated at all specified FDM levels so that a continuous scan will cover all possible combinations of the specified FDM levels.

EXAMPLE (CCITT): Continually scan all group pilots starting at group 1, of supergroup 2, of hypergroup 1, of supermastergroup 1.

Set the switches to the reference settings (paragraph 3-8).

Press [TR] [FREQ/FDM] [Any FDM key] - this sequence can be used at any time to load the FDM registers with the logical start and stop of the FDM plan chosen by the PLAN switches.
Press [CH] [0] - to eliminate a channel scan
Press [FREQ/FDM] [SCAN] [MEAS]

Frequency Display - Frequency of each group pilot
Level Display - level of each group pilot

EXAMPLE (BELL): Continually scan all group pilots starting at group 1, of supergroup 13, of mastergroup 1.

Set the switches to the reference settings (paragraph 3-8).

Press [TR] [FREQ/FDM] [Any FDM key] - this sequence can be used at any time to load the FDM registers with the logical start and stop of the FDM plan chosen by the PLAN switches.
Press [CH] [0] - to eliminate a channel scan
Press [FREQ/FDM] [SCAN] [MEAS]

Frequency Display - Frequency of each group pilot
Level Display - level of each group pilot.

3-76 At any time during a scan [HALT] may be pressed to halt the sweep. The [+↑] and [-↓] keys can then be used to step manually. Each time [+↑] or [-↓] is pressed, a single measurement of the level at the new frequency will be made and displayed. If [MEAS] is pressed again, the scan will continue from the point in the FDM plan specified by the FDM display but the direction of the scan will depend on whether the [+↑] or [-↓] key was the last one pressed.

3-77 If at any time a scan has been halted, the Transfer [TR] key can be used in conjunction with the [SCAN] [+↑] and [-↓] keys to specify the scan starting point and direction when the scan is restarted.

[TR] [SCAN] [MEAS] - Scans from the FDM limit held in the FDM Start or Stop Registers, modified by the current FDM description, in the same direction as the previous scan, ie, if the previous scan was from the Upper Limit down to the Lower Limit then the SCAN will start again at the FDM Upper Limit and scan down to the Lower Limit. Similarly, if the previous scan was from the Lower Limit up, then the scan will start again at the Lower Limit and scan up.

[TR] [SCAN] [+] [MEAS] - Scans up from the Lower FDM limit irrespective of the direction of the previous scan.

[TR] [SCAN] [-] [MEAS] - Scans down from the Upper FDM limit irrespective of the direction of the previous sweep.

Note: Once a scan has been started, any attempt to change the FILTER selected will Halt the scan. If changes in FILTER selection were allowed, then the auto calibration of the measuring circuits would no longer be valid. If a change in FILTER is required, press the appropriate FILTER key (which will Halt the scan) then press [SCAN] [MEAS]. A new autocalibration cycle will be initiated (CAL appears in Level Display) before the scan continues.

3-78. RESTRICTING A SCAN TO PART OF AN FDM PLAN

3-79 There are two methods available for restricting the scan within an FDM plan:

(1) Using FDM Start/Stop values and the Transfer [TR] key - FDM Start and Stop Values can be entered into FDM Start and Stop Registers in a similar manner to the Start and Stop Frequencies for a spectrum measurement. The step size will be the lowest specified FDM level.

EXAMPLE (BELL): Scan between channel 6, of group 1, of supergroup 13, of mastergroup 1 and channel 3 of group 3, of supergroup 13, of mastergroup 1.

Set the switches to the reference settings (see paragraph 3-8).

Press [START] [Any FDM key] - to bring forward the FDM Display
Press [CH] [6] [G] [1] [SG] [13] [HG/MG] [1]
Press [STOP] [Any FDM key]
Press [CH] [3] [G] [3] [SG] [13] [HG/MG] [1]
Press [TR] [SCAN] [MEAS]

FDM Display - stepping one channel at a time between the specified limits
Level Display - level of each channel

EXAMPLE (CCITT): Scan between channel 3, of group 1, of supergroup 2, of hypergroup 1, of supermastergroup 1 and channel 6, of group 5, of supergroup 2, of hypergroup 1 of supermastergroup 1.

Set the switches to reference settings (see paragraph 3-8).

Press [START] [Any FDM key] - to bring forward FDM Display
Press [CH] [3] [G] [1] [SG] [2] [HG/MG] [1] [SMG] [1]
Press [STOP] [Any FDM key]
Press [CH] [6] [G] [5] [SG] [2] [HG/MG] [1] [SMG] [1]
Press [TR] [SCAN] [MEAS]

FDM Display - stepping one channel at a time between the specified limits
Level Display - level of each channel

Note 1: All the types of scan available in the ordinary scan mode are available in this mode, ie pilots, group and supergroup powers etc.

Note 2:

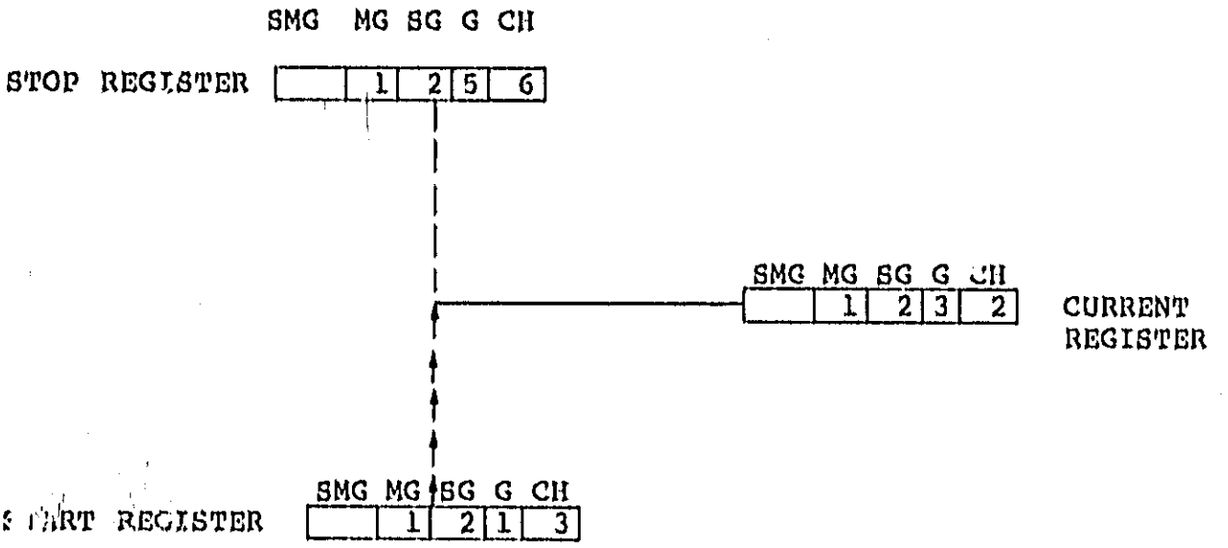


Figure 3-3(a) Example (1) of Register states when an FDM scan is halted.

Figure 3-3(a) shows the values loaded into the START and STOP Registers. The CURRENT Register will be continuously changing, one channel step at a time.

Consider the SLMS is halted and the FDM/FREQ display indicates MG1 SG2 G3 CH2 (the value of the CURRENT Register).
If keys [TR] [SCAN] [MEAS] are pressed the SLMS will load the contents of the START Register into the CURRENT Register and the SLMS will re-start the scan from that point, in this case 1213.

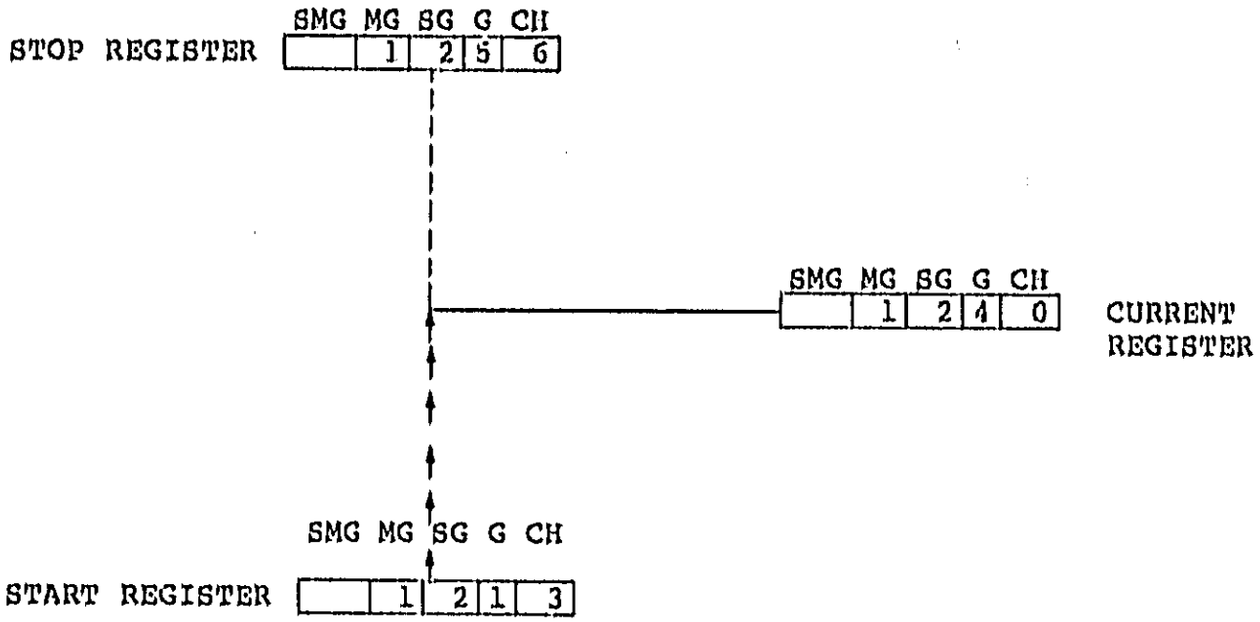


Figure 3-3(b) Example (2) of Register state when an FDM scan is halted.

Figure 3-3(b) shows the same values loaded into the START and STOP Registers as in Figure 3-3(a). This time however the SLMS is halted, and the CH entry changed to 0, such that the FDM/FREQ display (and CURRENT Register) indicates 1240. If keys [TR] [SCAN] [MEAS] are pressed, the SLMS overwrites the CURRENT Register with the contents of the START Register except where the CURRENT Register shows 0, i.e. the SLMS will re-start the SCAN from 1210, with the CURRENT Register changing one group step at a time.

Pressing [TR] [SCAN] sets the significant (i.e. non-zero) levels of the current FDM description equal to either the START FDM values or the STOP FDM values, depending on the current direction of sweep. This key sequence does not necessarily make the current FDM description equal at every level to the START/STOP description. The current measurement type (mastergroup pilot scan, supergroup pilot scan, etc) is thereby retained.

(2) Fixing using the decimal point [.] key - the 3746A will normally scan all the specified levels in the FDM hierarchy. It is possible however, to restrict the scan by holding part of the FDM description fixed. Only the FDM levels below the fixed level will then be incremented during the scan. For example, only the the channels in group 3, of a basic group may be scanned.

To fix part of the FDM description, the decimal point [.] key is pressed immediately after the entry of the FDM level which is to remain fixed. To indicate which parts of the FDM description are fixed, the decimal point in the FDM Display at each fixed level is illuminated. Note that fixing one level of an FDM description automatically fixes all higher levels.

EXAMPLE (CCITT): Scan all group pilots in mastergroup 8, of supermastergroup 2 starting from group 1, of supergroup 4.

Set all the switches to the reference settings (see paragraph 3-8).

Press [Any FDM key] - To bring forward the FDM Display
Press [CH] [0] [G] [1] [SG] [4] [SMG] [2] [HG/MG] [8] [.]
Press [SCAN] [MEAS]
If [.] had been omitted from the above sequence then all 225 Group Pilots in plan 1B would have been scanned.

EXAMPLE (BELL): Scan all group pilots in supergroup 15, of mastergroup 2, starting at group 1. Set all switches to the reference settings (see paragraph 3-8).

Press [Any FDM key] - To bring forward FDM Display.
Press [CH] [0] [G] [1] [HG/MG] [2] [SG] [1] [5] [.]
Press [SCAN] [MEAS]
If [.] had been omitted from the above sequence then all 300 Group Pilots would have been scanned.

Note: The lowest FDM level to be fixed is the last entered before the [.] key is pressed.

To remove the restriction on the scan, press the FDM description key of the lowest fixed segment. The decimal points in the FDM description will be extinguished and any new valid FDM data may be entered.

The range of an FDM scan is also influenced by the setting of the MASTER GPS/SYSTEM BW switch.

3-80 FDM SKIPS

3-81 If an FDM network has sections of the plan which are not loaded, the 3746A can be programmed to "Skip" up to 30 of these sections. FDM skips can only be entered down to supergroup level, ie, groups and channel levels cannot be entered in the FDM description for a skip.

3-82 To gain access to the FDM skip registers, press [TR] [1] [0]. The TEST-POINT Display, which is used in this function as a register pointer, should contain the first location 'F01'. If position F01 has not had an FDM description entered previously, then the FREQ/FDM display will contain either all zeros, or a mixture of zeros and dashes. To enter an FDM skip press the FDM level description key required followed by the numeric entry required. Press the [↓] key to move the pointer to the next location and enter the next FDM skip. Up to 30 FDM skips may be stored in this way. The register pointer can be moved up or down at any time using the [↓] and [↑] keys.

3-83 After the required entries have been made in the FDM skips Register, increase the register pointer to the next position and Terminate the FDM skips register by pressing [CLEAR/SET]. All FDM measurements (pilots, channel levels, group and supergroup powers etc) can be performed as normal except that during a scan when an FDM description falls within an FDM level stored as a skip, the 3746A will automatically jump to the next FDM level outside that specified by the skip.

EXAMPLE (BELL): Continually scan all supergroup powers starting at mastergroup 1, supergroup 13 and missing out the following supergroups:

MG 2, SG 17
MG 3, SG 15
MG 4, SG 17
MG 5, SG 26

Set the switches to the reference settings (see paragraph 3-8).

Press [TR] [1] [0]
Press [SG] [1] [7] [HG/MG] [2]
Press [↓] [SG] [1] [5] [HG/MG] [3]
Press [↓] [SG] [1] [7] [HG/MG] [4]
Press [↓] [SG] [2] [6] [HG/MG] [5]
Press [TR] [FREQ/FDM] [CH] - 1, 13, 1,1 should appear in the FREQ/FDM Display, which is the logical start of the plan.
Press [CH] [0] [G] [0] [SG/GP POWER] [SCAN] [MEAS]

The FREQ/FDM Display should scan through all the supergroups in the plan except those supergroups specified by the FDM skips register.

EXAMPLE (CCITT): Continually scan all supergroup powers starting at supergroup 2 of hypergroup 1, of supermastergroup 1 and missing out the following supergroups:

SMG 1, HG 1, SG 9
SMG 2, HG 7, SG 6
SMG 2, HG 9, SG 5
SMG 3, HG 9, SG 6

Set the switches to the reference settings (see paragraph 3-8).

Press [TR] [1] [0]
Press [SG] [9] [HG/MG] [1] [SMG] [1]
Press [↑] [SG] [6] [HG/MG] [7] [SMG] [2]
Press [↑] [SG] [5] [HG/MG] [9] [SMG] [2]
Press [↑] [SG] [6] [HG/MG] [9] [SMG] [3]
Press [TR] [FREQ/FDM] [CH] - 1, 1, 2, 1, 1 should appear in the FREQ/FDM Display which is the logical start of the plan.
Press [CH] [0] [G] [0] [SG/GP POWER] [SCAN] [MEAS]

The FREQ/FDM Display should scan through all the supergroups in the plan except those supergroups specified by the FDM skips register.

Note: The FDM Skip Register should be cleared after the measurement unless it is intended to retain the skips. The Skips Register can be cleared by pressing [TR] [1] [0] and clearing each individual FDM skip using [CLEAR/SET] after accessing the skip with the register pointer.

3-84 SPECTRUM OF FDM SEGMENTS

3-85 The Start Frequency and Stop Frequency Registers can be loaded with the maximum and minimum frequencies of any FDM segment specified by the FDM Display. The registers are loaded when the description of an FDM Level is in the FDM/FREQ Display and [SPECT] is pressed (the lowest segment specified being loaded).

3-86 This facility may be used, for example, to perform a Spectrum within an FDM level to locate spurious tones.

EXAMPLE (BELL): Make a Spectrum sweep across channel 5, of group 4, of supergroup 13, of mastergroup 1 using 20Hz frequency steps.

Set the switches to the reference settings (see paragraph 3-8).

Press [STEP] [.] [0] [2]
Press [Any FDM key] - to bring forward the FDM Display
Press [CH] [5] [G] [4] [SG] [1] [3] [HG/MG] [1]
Press [SPECT] [MEAS]

Frequency Display - Frequency at 20Hz intervals, across the selected channel (640.000kHz to 644.000kHz).
Level Display - Level at each frequency

EXAMPLE (CCITT): Make a Spectrum sweep across channel 6, of group 5, of supergroup 3, of hypergroup 1, of supermastergroup 1 using 20Hz frequency steps.

Set the switches to the reference settings (see paragraph 3-8).

Press [STEP] [.] [0] [2]
Press [Any FDM key] - to bring forward the FDM Display
Press [CH] [6] [G] [5] [SG] [3] [HG/MG] [1] [SMG] [1]
Press [SPECT] [MEAS]

Frequency Display - Frequency at 20Hz intervals across the selected channel (588.000kHz to 592.000kHz)
Level Display - level at each frequency.

3-87 NON-STANDARD PILOTS

3-88 If the pilots used in an FDM system are not those held in the 3746A memory, then the 3746A may be tuned to these pilots either manually by means of the [FREQ] and numeric keys or by storing the required basic pilot frequency in the Non-Standard Pilot Register.

3-89 The Non-Standard Pilot Register is selected when the PILOT switch is set to the NS position. An entry is made into the Non-Standard Pilot Register by pressing [NS PILOT] and using the numeric keys to specify the required frequency.

3-90 The frequency held in the Non-Standard Pilot Register is applied as an offset from the Virtual Carrier (VC) of the current FDM description. The offset, which may be positive or negative with respect to the VC is automatically applied by the 3746A depending on whether the FDM segment being measured is erect (+ve offset) or inverted (-ve offset). If the lowest specified level is a group, then the frequency held in the Non-Standard Pilot Register will be interpreted as the frequency of a pilot in the basic group and the 3746A will tune to the frequency that this pilot would occupy in the group specified by the FDM Display.

Note: Remember to set the PILOT switch back to the appropriate group pilot position when the Non-Standard pilot is no longer required.

EXAMPLE (CCITT): Tune to group 4 pilot, of supergroup 6, of mastergroup 8, of supermaster group 2, when the basic group pilot is 84.14kHz.

Set the switches to the reference settings (see paragraph 3-8) except set the PILOT switch to the NS position.

Press [NS PILOT] [8] [4] [.] [1] [4]
Press [Any FDM key] - To bring forward the FDM Display
Press [CH] [0] [G] [4] [SG] [0] [HG/MG] [8] [SMG] [2]
Press [FREQ/FDM] [MEAS]
Frequency Display - 6220.140kHz
Level Display - Pilot Level

EXAMPLE (BELL): Tune to group 4 pilot, of supergroup 16, of mastergroup 3 when the basic group pilot is 92.15kHz.

Set the switches to the reference settings (see paragraph 3-8) except set the PILOT switch to the NS position.

Press [NS PILOT] [9] [2] [.] [1] [5]
Press [Any FDM keys] - To bring forward the FDM Display
Press [CH] [0] [G] [4] [SG] [1] [6] [HG/MG] [3]
Press [FREQ/FDM] [MEAS]
Frequency Display - 7699.850kHz
Level Display - Pilot Level

3-91 VIRTUAL CARRIER MEASUREMENTS

3-92 If the PILOT switch is set to the VC position (Virtual Carrier) then the 3746A, will tune to the virtual carrier frequency of the lowest level specified in the FDM Display, enabling measurements of carrier leak to be made.

Note: Since basic levels of the multiplex have, by definition, no carrier, the virtual carrier of any basic level will be interpreted as 0kHz. The 3746A cannot make measurements at 0kHz and since it would be undesirable to have a Scan stop, or an error code indicated, then in these circumstances the 3746A will correctly indicate a virtual carrier of 0kHz for basic FDM levels. However, the level measurement displayed will be erroneous and should be ignored.

EXAMPLE: tune to the virtual carrier of group 3 in the basic supergroup.

Set the switches to the reference settings (see paragraph 3-8) except set the PILOT switch to VC.

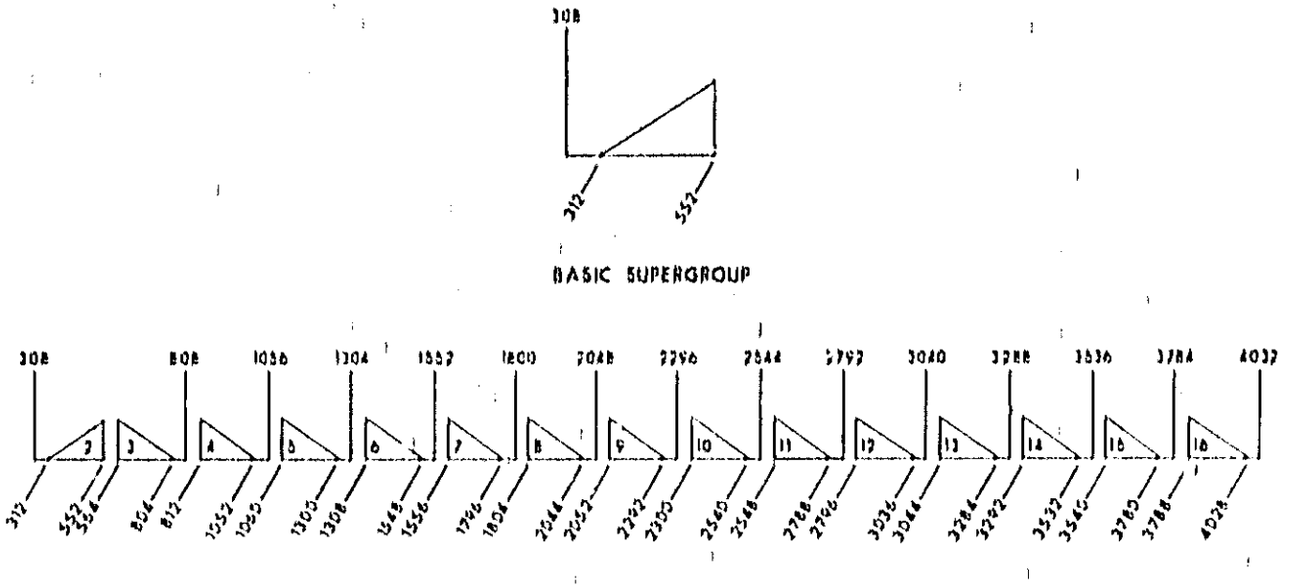
Press [Any FDM key] - To bring forward the FDM Display
Press [G] [3] and enter [0] in all other FDM level.
Press [FREQ/FDM] [MEAS]
Frequency Display - 516kHz
Level Display - Carrier Level

3-93 INTERSUPERGROUP SLOT MEASUREMENTS

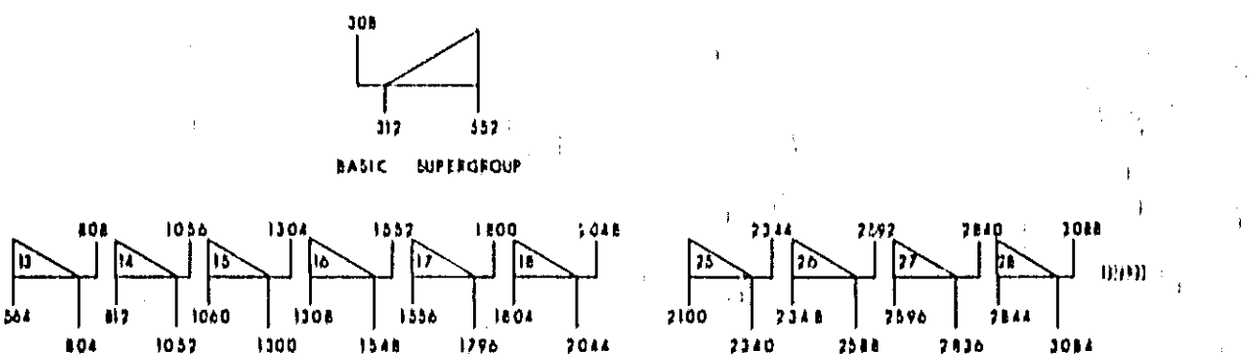
3-94 The Non-Standard Pilot Register may be used to simplify tuning to the frequencies within the guardbands between supergroups (intersupergroup slots). The Non-Standard Pilot Register is loaded with a frequency which when translated up the multiplex (as a supergroup pilot) will always tune the 3746A to a frequency within an intersupergroup slot.

Note: The 3.1kHz or WTD filter should be selected manually.

3-95 For example, if the Non-Standard Pilot Register is loaded with 308kHz and the FDM description of a supergroup within the basic hypergroup (CCITT)/U600 mastergroup (BELL) is entered, the 3746A will tune within the instersupergroup slots as illustrated in Figure 3-4.



(a) Basic Hypergroup Showing Intersupergroup Slot Frequencies



(b) Basic U600 Mastergroup Showing Intersupergroup Slot Frequencies

Figure 3-4 Intersupergroup Slot Frequencies

EXAMPLE (BELL): Scan all intersupergroup slots in the basic mastergroup.

Set the switches to the reference settings (see paragraph 3-8), except set the PILOT switch to NS.

Press [NS PILOT] [3] [0] [8]
Press [Any FDM key] - To bring forward the FDM Display.

EXAMPLE (BELL): (continued)
Press [SG] [1] [3] - Set all other FDM levels to [0].
Press [3.1kHz] / [WTD] [SCAN] [MEAS]
Frequency Display - Frequency of each intersupergroup slot
Level Display - Level in each intersupergroup slot

EXAMPLE (CCITT): Scan all intersupergroup slots in the basic hypergroup.

Set the switches to the reference settings (see paragraphs 3-8), except set the PILOT switch to NS.

Press [NS PILOT] [3] [0] [8]
Press [Any FDM key] - To bring forward the FDM Display
Press [SG] [2] - Set all other FDM levels to [0]
Press [3.1kHz] [WTD] / [SCAN] [MEAS]
Frequency Display - Frequency of each intersupergroup slot
Level Display - Level in each intersupergroup slot

3-96 FREQUENCY OFFSET OF FDM PLANS

3-97 The frequency offset facility allows all the stored FDM plan frequencies to be offset by any amount, in 1Hz steps. The effect is to offset the frequency to which the 3746A would normally tune by the frequency held in the Offset Frequency Register. Additionally, all other frequencies derived from FDM descriptions will be offset by the same amount, ie, during spectrum sweeps of FDM segments (see paragraph 3-84) the content of the Start Frequency and Stop Frequency registers would have the offset applied.

Note: Frequency Offset cannot be applied to non FDM based measurements, ie, when the 3746A is tuned using the [FREQ] key.

3-98 The content of the Offset Frequency Register is always applied to FDM based measurements. At switch-on, the content of the register is 0kHz which ensures there is no offset applied. Entries are made into the Offset Register by pressing [TR] [STEP] and specifying the desired frequency offset in kHz using the numeric keys. Offsets may be entered as either a positive or negative frequency using the [+↑] or [-↓] keys. If neither is pressed a positive frequency offset is assumed. To cancel the offset, enter an offset of 0kHz by pressing [TR] [STEP] [0].

CAUTION

If the positive or negative offset entered is too large, the 3746A will be taken outside its frequency range resulting in error condition (E16)

3-99 MODIFYING FDM PLANS

3-100 Some standard modifications are available to the FDM plans stored within the 3746A. CCITT Plans 1B and 2 can be modified to include Supergroup 1. The Bell U600 MMX-1 and MMX-2 plans can be modified to include; 1) Supergroup 12 in the first mastergroup, 2) Supergroup 11 and 12 in the first mastergroup, 3) the first ten supergroups in a CCITT hypergroup in place of the first mastergroup.

Note: Only one of these modifications is permitted at any one time.

3-101 The modifications are introduced into the plans as follows:

CCITT Plans 1B and 2
To include Supergroup 1 press [TR] [Any FDM keys] [SG] [1]

Note: Supergroup 1 may also be extended to include Group A by pressing [G] [8] after entering SG1.

BELL Plans U600 MMX-1 and MMX-2
To include Supergroup 12 press [TR] [Any FDM key] [SG] [1] [2]
To include Supergroup 11 and 12 press [TR] [Any FDM key] [1] [1]
To replace the first mastergroup with the first ten supergroups in a CCITT hypergroup press [TR] [Any FDM keys] [SG] [1] [0]

To cancel a plan modification, press [TR] [Any FDM keys] [SG] [Any valid Supergroup number].

3-102 The effect of applying these modifications to the stored plans is illustrated in Section VII.

3-103 Extending CCITT Plans 1A and 2 to 16MHz

3-104 CCITT plans 1A and 2 can be extended to 4 Supermastergroups and 4 Hypergroups respectively. Plan selection requires access to an internal switch (see Section II) and should only be performed by service trained personnel who are aware of the hazards involved. Front panel switch settings are included in Section II.

3-105 MODES OF OPERATION

3-105 (a) OUT OF LIMITS DETECTION AND LIMIT ALARMS

3-106 The levels measured by the 3746A are continually compared against internal level limits. If the measured signal level falls outside these limits, an indication is given by annunciators in the Level Display indicating either Upper Limit (ULIM) or Lower Limit (LLIM) as appropriate.

3-107 The level limits are relative to the level held in the Reference Level Register and are determined by the contents of the Upper and Lower Limit Registers. For example, if the reference level is -45dBm and the contents of the Upper Limit Register is 5 and the Lower Limit Register is -10, then an out of limits indication is given if the measured signal is greater than -40dBm or less than -55dBm.

3-108 Pressing either [REF], [UPPER] or [LOWER] displays the contents of the appropriate register and allows new data to be entered using the numeric keys (see the relevant key descriptions in Section VI).

3-109 The upper limit is normally entered as a positive value and the lower limit as a negative value relative to the reference level. To enter the reference level or lower limit as a negative value the [-] key should be pressed before or after entering its value, otherwise a positive value is assumed.

3-110 The LIMIT switch determines which if any of the out of limits conditions will cause a Limit Alarm, ie, Lower (LO) Upper (HI) or Both (BOTH). Limit Alarms can be used to halt a measurement, cause a printer to print the measurement result, or hold a tracking generator at the current frequency, (depending on the settings of the GEN TRACK, LIMIT HALT and PRINTER switches).

3-111 Limit Halt Sweep

3-112 A Limit Halt sweep is a continuous Spectrum or Scan in which the 3746A is programmed to stop at any frequency where a Limit Alarm occurs. The LIMIT HALT switch is set to ON and the LIMIT switch is set to the out of limits condition which will cause an alarm, ie, Low, High or Both.

3-113 The sweep will now stop during a Scan or Spectrum measurement whenever a Limit Alarm occurs. The sweep will not proceed if the signal returns within limits, and will only proceed if [MEAS] is pressed.

3-114 GENERATOR TRACKING

3-115 A Frequency Generator/Synthesiser may be set to track the frequency to which the 3746A tunes, in either a Scan or Spectrum measurement. Two basic modes of tracking are possible, either open loop or closed loop tracking via the Hewlett-Packard Interface Bus (HP-IB).

3-116 Closed Loop Tracking (via HP-IB)

3-117 In the two BUS tracking modes (STAB and LIM) of the GEN TRACK switch the 3746A controls the frequency of a suitable Generator via the HP-IB. The HP-IB interface requires that the Frequency Generator be set to a specific listen address before information may be passed from the 3746A. Section V contains information on the interconnection of a Frequency Generator and the 3746A on the HP-IB.

3-118 The 3746A can be set to output the frequency data in various formats to suit a variety of Frequency Generators. Output format is determined by the setting of the switches on the rear panel Device Address switch. Several H-P Frequency Generators are recommended for use with the 3746A (see section V).

3-119 BUS STAB (STABILITY) —— Each time the 3746A tunes to a new frequency it instructs the Frequency Generator via the HP-IB to go to the same frequency. A minimum of two measurements is made at each frequency in the sweep and the 3746A will only proceed to the next frequency in the sweep if both the following conditions are met:

1. Two consecutive measurements at the same frequency are within 1dB with [AVE] [0] selected, 0.2dB with [AVE] [1] selected or 0.05dB with [AVE] [2] selected.

2. The current measurement is within the limits set up in the [REF], [UPPER] and [LOWER] registers.

3-120 BUS LIM (LIMIT) —— Each time the 3746A tunes to a new frequency it instructs the Frequency Generator via the HP-IB to go to the same frequency. The 3746A will stop at any point in the sweep where a measurement is outside the limits set up in the [REF], [UPPER] and [LOWER] registers and continuously monitor the level at this point. When a measurement comes within limits the sweep will proceed to the next point.

Note: When the 3746A is Halted the [+↑] and [-↓] keys cannot be used to step the sweep manually in the STAB and LIM positions.

For both these Generator Tracking modes, suitable values must be entered in the Upper, Lower and Reference Level Registers.

3-121 Open Loop Tracking

3-122 In the Open Loop (O/LP) tracking mode of the GEN TRACK switch, the signal path is the only link required between the Frequency Generator and the 3746A. The Frequency Generator must step through the same sequence of frequencies as the 3746A and must spend sufficient time at each frequency to allow the 3746A to make a valid measurement.

3-123 Two tests are applied to each measurement result to ensure that the Frequency Generator and the 3746A are tuned to the same frequency. The 3746A will not proceed to the next frequency until the tests at the current frequency are satisfied. The tests used are:

1. Two consecutive measurements at the same frequency are within 1dB with [AVE] [0] selected, 0.2dB with [AVE] [1] selected or 0.05dB with [AVE] [2] selected.

2. The current measurement is within limits.

Note: Suitable values must be entered in the Upper, Lower and Reference Level Registers.

3-124 Tracking Generator (Option 012)

3-125 On instruments fitted with option 012 a TRACKING GENERATOR output, which tracks the frequency to which the 3746A is tuned, is available on the rear panel. The output level is a nominal -10dBm (75 ohm) with a flatness better than +/-0.2dB.

3-126 EQUALIZATION

3-127 Cabling from test points (via Access Switches) to the 3746A can introduce frequency dependent errors. The 3746A has an equalization routine available which can apply frequency dependent results correction to any measurement made. Correction is stored in the form of 32 equalization coefficients evaluated from measurements made at 1MHz intervals between 500kHz and 31.5MHz during an equalization cycle (or loaded via the HP-IB from an external controller).

3-128 In order to perform an equalization cycle the 3746A must be connected (through the cable path to be equalized) to a suitable Frequency/Level Generator either in the open loop mode, or in the closed loop mode via the HP-IB (see paragraphs 3-114 and 3-118). In closed loop operation the Generator output level will be automatically set to the level held in the 3746A Reference Level Register. For open loop operation the Generator output level must be set manually to the level held in the 3746A Reference Level Register.

3-129 Pressing [TR] [dB/dBm] [MEAS] will initiate the equalization cycle and in the closed loop mode will send the content of the Reference Level Register to the Generator to enable it to set its output level. The 3746A will perform a spectrum measurement at 1MHz intervals between 500kHz and 31.5MHz and will store the difference between the measured level and reference level as a correction factor to be applied to future measurements.

3-130 Pressing [TR] [+] [dB/dBm] turns the equalizer on and when a measurement is performed, correction will be applied according to the results stored during the equalization cycle. Pressing [TR] [-] [dB/dBm] turns the equalizer off.

3-131 VOICE CHANNEL DEMODULATION

3-132 When the 3.1kHz, WTD or notch filter is selected, a demodulated voice channel is present on the front panel loudspeaker and PHONE jack plug. The demodulated voice channel is also available on both rear panel AUDIO outputs (Jack or Siemens 3-pin) at a level between -3 and -13dBm into 600 ohm.

3-133 If a channel is selected by an FDM description then the demodulator always produces an erect channel, even if the measured channel is inverted.

3-134 Channel measurements made with the 3746A tuned to the channel carrier by the [FREQ] key must be offset from the carrier by either +1.85kHz for erect channels or -1.85kHz for inverted channels. Pressing either [TR] [UPPER] or [TR] [LOWER] will ensure correct demodulation for erect or inverted channels respectively.

3-135 REAL TIME CLOCK

3-136 The 3746A has an internal non-volatile real-time clock. The time can be brought forward and displayed in the FREQ/FDM Display. The display can be toggled between Hours/Minutes/Seconds and Day/Month/Year by the [FREQ/FDM] key.

3-137 Pressing [TR] [1] [9] will access the clock and display time. To change the display to date, press the [FREQ/FDM] key.

3-138 Setting Time and Date

3-139 Time: to set the time on the clock press [TR] [1] [9] to bring the time into the display.

Press [SMG] - enter hours using numeric keys
Press [SG] - enter minutes using numeric keys
Press [CH] - clears seconds display to 00
Press [START] - to start clock when required.

Note: the clock stops whenever [SMG] [SG] or [STOP] is pressed.

3-140 Date: to set the date on the clock press [TR] [1] [9] [FREQ/FDM] to bring the date into the display.

Press [SMG] - enter day using numeric keys
Press [SG] - enter month using numeric keys
Press [CH] - enter year using numeric keys
Press [START] - to restart the clock.

Note: the clock stops whenever [SMG] [SG] or [CH] is pressed.

3-141 When the 3746A is connected to a printer and is acting as a controller measurement results will include a print-out of time and date (see sections IV and V).

3-142 AUTO CALIBRATION CYCLE

3-141 The 3746A will perform an auto calibration cycle using its own internal 1MHz, -25dBm calibration signal under the following conditions:

1) At switch-on

2) Every 10 minutes thereafter

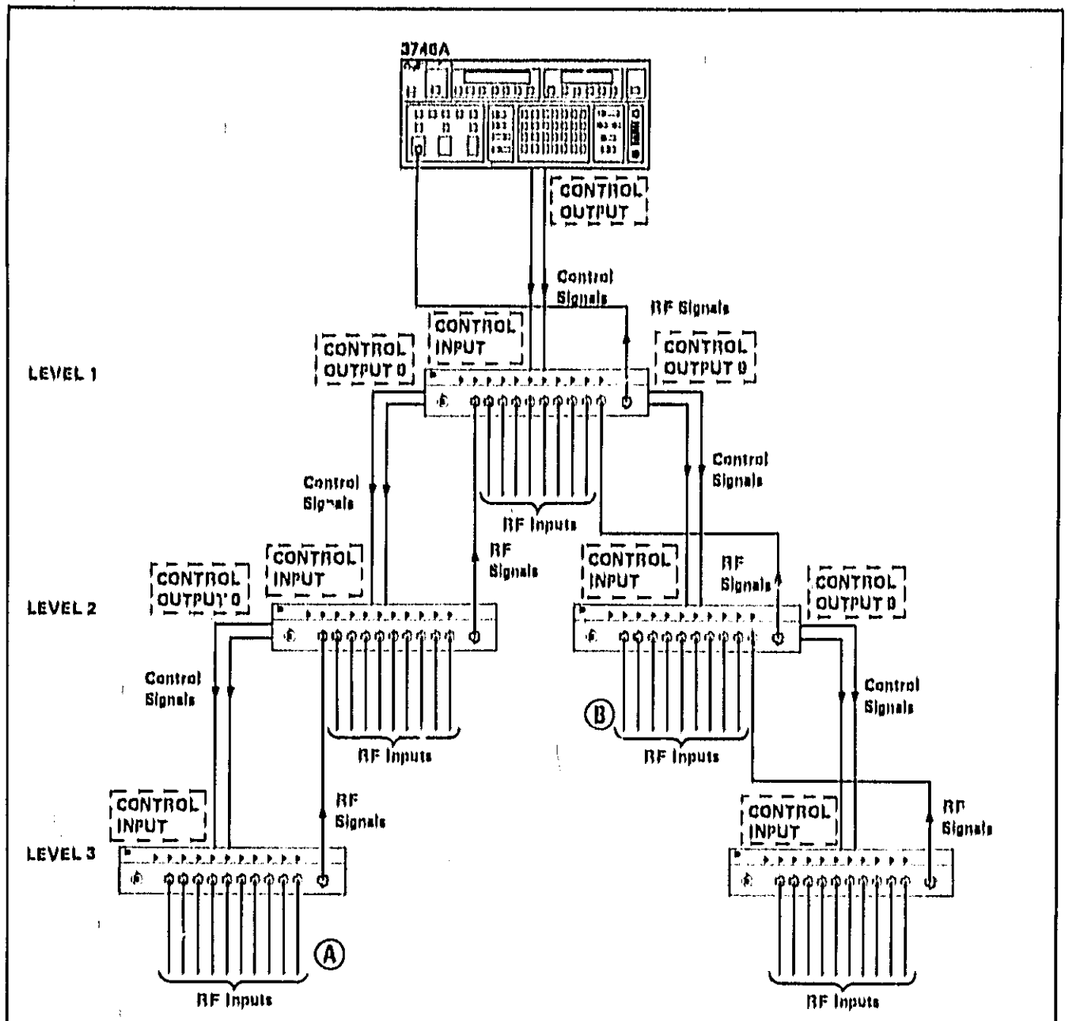
3) If the filter or averaging is changed.

When a calibration cycle is in progress the word 'CAL' will appear in the Level Display.

3-144 Pressing [TR] [2] [9] measures, displays and if the 3746A is connected to a printer, prints the frequency and level of the calibration signal.

3-145 ACCESS SWITCH SELECTION

3-146 The 3746A has a built-in Access Switch Controller capable of accessing up to 1000 test points, ie, 111 Access Switches (HP Models 3754A, 3756A and 3757A). For all Switch models, control from the 3746A to the first Switch Level is via a 2-wire control output on the 3746A rear panel. For Models 3754A and 3757A only, subsequent levels may be controlled via the 2-wire control path or via the co-ax carrying the RF signal from the Access Switch. The 3756A control is by 2-wire at all levels.

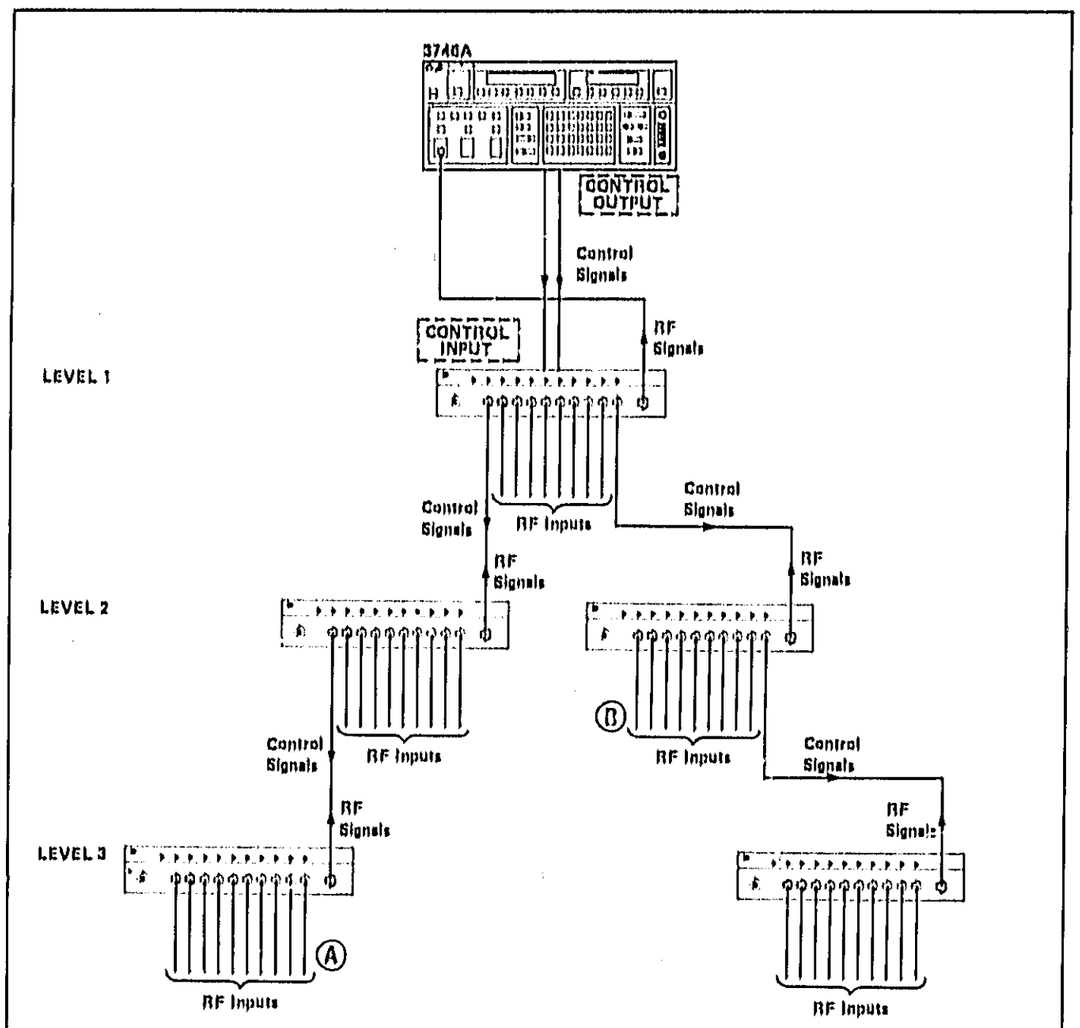


LEVEL 1 Access Switch is connected to the 3746A and set to receive control pulses via the 2-wire control path.

LEVEL 2 Up to 10 Access Switches may be connected to level 1. The Access Switches are all connected and set to receive control pulses via the 2-wire control path.

LEVEL 3 Up to 100 Access Switches may be connected (if 10 are present at level 2). All the Access Switches are connected and set to receive control pulses via the 2-wire control path.

Figure 3-5 3746A and 3754A/3756A/3757A Cascading Access Switches — Connection Using 2-wire Control Path

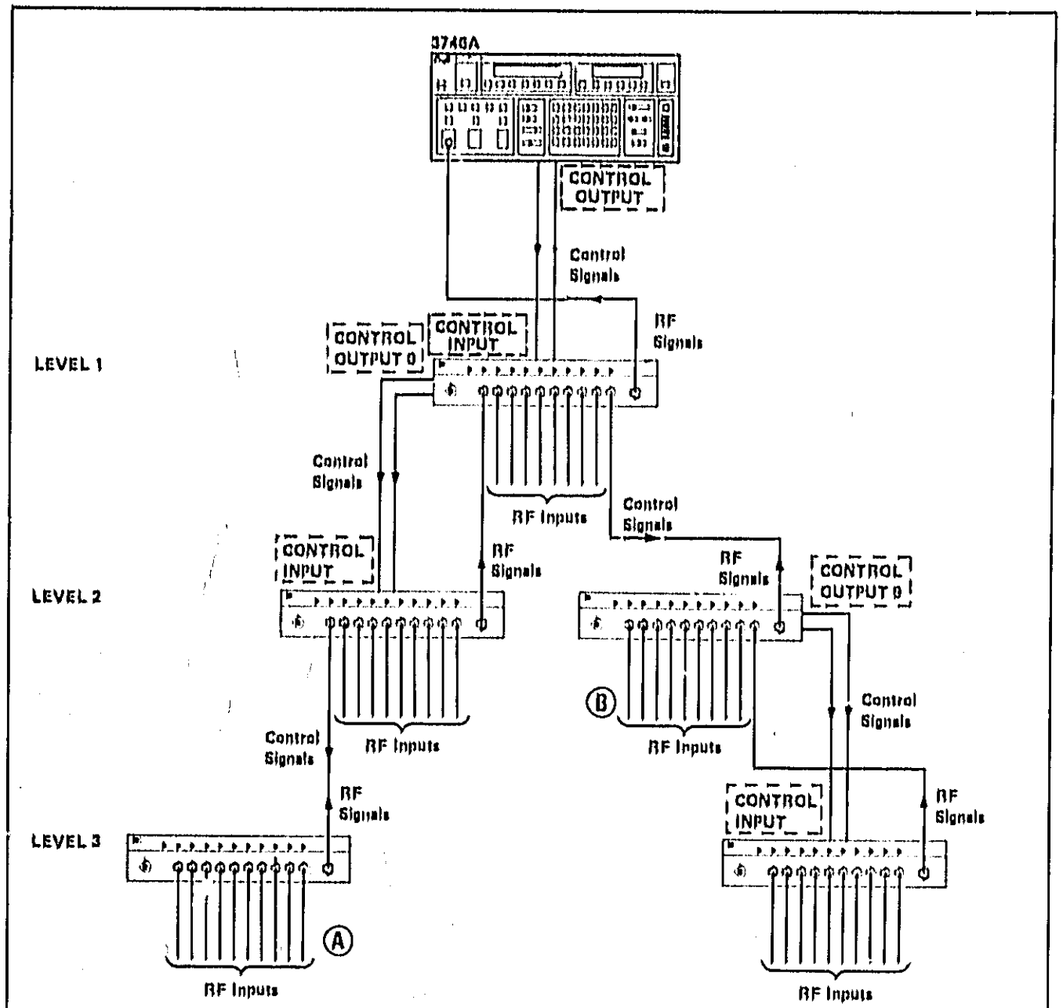


LEVEL 1 Access Switch is connected to the 3746A and must be set to receive control pulses via 2-wire and retransmit control pulses via co-ax.

LEVEL 2 Up to 10 Access Switches may be connected to level 1. The Access Switches are all set to receive/retransmit control pulses via co-ax.

LEVEL 3 Up to 100 Access Switches may be connected to level 2 — if 10 Access Switches are available at level 2. The Access Switches are set to receive control pulses via co-ax.

Figure 3-6 3746A and 3754A/3757A Cascading Access Switches — Connection Using Co-ax Cables Only, after Level One



LEVEL 1 Access Switch is connected to the 3746A and must be set to receive control pulses via 2-wire and retransmit via either co-ax or 2-wire control path.

LEVEL 2 Up to 10 Access Switches may be connected to level 1. The Access Switches may be set to receive control pulses via the 2-wire control path (LHS Switch) or via the co-ax (RHS Switch) since the Access Switch at level 1 is set for dual transmission. All the Access Switches on level 2 are set to retransmit via co-ax (dual mode).

LEVEL 3 Up to 100 Access Switches may be connected (if 10 are present at level 2). The Access Switches may be set to receive control pulses via the 2-wire control path or via co-ax as required.

Figure 3-7 3746A and 3754A/3757A Cascading of Access Switches — Connection Using Combination of 2-wire Control Path and Co-ax

Figure 5
Figure 6

3-147 A rear panel POWER SUPPLY OUTPUT of +/-15V dc is also available for supplying dc power to four 3757A Access Switches unless Option 013 is fitted, in which case only one 3757A Access switch can be powered.

3-148 Figures 3-5, 3-6 and 3-7 show methods of cascading Access Switches. A maximum of 3 levels of cascading is allowed, although the RF inputs may be connected at any level. The inputs in a cascaded system are selected by addressing the input required through any intermediate levels which may be connected. For example in Figures 3-5, 3-6 and 3-7, the A and B inputs are selected as follows:

Input A

Press [CLEAR/SET] - to disconnect any input which was previously selected and clear the 3746A Test Point Display.

Press [0] - to select input 0 on the first level Access Switch.

Press [0] - to select input 0 on the second level Access Switch.

Press [9] - to select input 9 on the third level Access Switch.

Input B

Press [CLEAR/SET] - to disconnect any input which was previously selected and clear the 3746A Test Point Display.

Press [9] - to select input 9 on the first level Access Switch.

Press [0] - to select input 0 on the second level Access Switch.

Note: The number of the test point selected will appear in the Test Point Display. The TEST POINT SPEED switch on the 3746A rear panel should be set to coincide with speed selected on the Access Switches.

3-149 OPTIONS

3-149 (a) Channel Impairment Options

3-150 Channel Impairments Options 015 and 016 provide the following capability:

1) Weighted filter - Option 015 CCITT (psophometric)
- Option 016 BELL (C-message)

2) 3-band phase jitter measurement

3) Impulse noise (single threshold) measurement.

4) Noise with tone (notched noise) measurement.

3-151 Weighted Filter

3-152 Option 015 provides a psophometrically weighted filter and Option 016 provides a C-message weighted filter superimposed on the standard 3.1kHz filter. The filters allow weighted noise measurements to be made on a voice channel at line frequencies.

3-153 Weighted noise measurements are made on voice channels in a similar manner to measurements made with the 3.1kHz filter (see paragraph 3-59) except that the [WTD] key is selected. Measurement results are displayed in dBm (or dB's relative to the REF level) with the relevant weighting applied.

Note: Weighted channel measurements made with the 3746A tuned to the channel carrier by the [FREQ] key, must be offset by either +1.85kHz for erect channels or -1.85kHz for inverted channels. Pressing [TR] [UPPER] or [TR] [LOWER] will ensure correct demodulation for erect or inverted channels respectively. Tuning by means of an FDM description however will automatically ensure that the channel is demodulated correctly.

3-154 Noise with Tone

3-155 To make a notched channel (Noise with Tone) measurement, press [NWT] [WTD] - the channel filter will be automatically selected with the weighted and notch filters superimposed. The notch filter suppresses a demodulated tone at 1010Hz +/-15Hz by at least 50dB and allows measurements in the presence of the tone to be made. Erect or inverted sideband demodulation is available by pressing [TR] [UPPER] for erect, or [TR] [LOWER] for inverted.

3-156 The [WTD] and notch [NWT] filters are automatically deselected if [IMP NOISE], [Ø JITTER] or any other filter key is pressed.

3-157 Phase Jitter

3-158 The [Ø JITTER] key allows phase jitter measurements to be made on a suitable test tone (normally injected into a voice channel). Phase jitter measurements are made on the test tone after demodulation by the 3746A and the demodulated test tone must be within the range 9050Hz to 1050Hz.

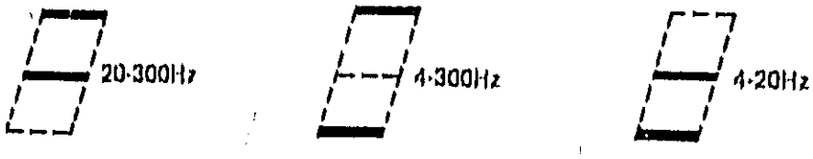
3-159 Three bandwidth ranges are provided for phase jitter measurements - 4Hz to 20Hz, 4Hz to 300Hz and 20Hz to 300Hz. Measurement bandwidth is selected by:

1) Pressing the [Ø JITTER] key once (20-300Hz), twice (4-300Hz) or three times (4-20Hz) - pressing key again rolls round to start (20-300Hz).

   or

2) Pressing [Ø JITTER] followed by [0] (20-300Hz), [1] (4-300Hz) or [2] (4-20Hz).

The selected bandwidth is indicated in the LEVEL Display using the last digit in the following manner:



3-160 For phase jitter measurements the 3746A will automatically select the 3.1kHz filter which is centered on 1.85kHz. To ensure that the frequency of interest (test tone) is correctly demodulated by the 3746A to produce the 1kHz tone required, the frequency to which the 3746A is tuned must be offset by 850Hz. The offset from the sideband centre frequency will be +850Hz for erect channels (upper sideband) or -850Hz for inverted channels (lower sideband). Erect sideband demodulation is selected by pressing [TR] [UPPER] and inverted sideband demodulation by [TR] [LOWER]. If the 3746A is tuned to a channel using an FDM description, then correct demodulation of the test tone is automatic.

3-161 A calibration cycle is initiated each time the [Ø JITTER] key is pressed and 11-13 seconds will elapse before the first result is displayed. Subsequent results are displayed at approximately 2 second intervals. Halting the measurement with the [HALT] key and restarting with the [MEAS] key will avoid starting another calibration cycle.

Note: The 3746A may take up to 4 seconds to halt the current measurement after the [HALT] key is pressed.

3-162 Measurement results are displayed in the LEVEL Display in degrees peak-to-peak (o pk-pk). Accuracy depends on the bandwidth selected (see Table of Specifications in Section I).

3-163 Error Condition 92: If error code E92 (no tone available) appears in the TEST POINT Display when a phase jitter measurement is attempted then either;

1) the signal is absent, in which case the instrument will autorange on channel noise

   or

2) the signal is at the wrong frequency, ie, outside the +/-50Hz centred on 1010Hz. Possibly cured by retuning or selection of proper sideband.

3-164 Impulse Noise

3-165 During an Impulse Noise measurement the 3746A monitors the level of a signal over a defined time period, counting the number of times the signal level violates a preset threshold. The maximum count rate for Option 015 (CCITT) is 8/sec and for Option 016 (BELL) is 7/sec.

3-166 Measurement parameters are entered using the [IMP NOISE], [TIME], [THRESH] and Numeric keys. Pressing [IMP NOISE] displays Measurement Period in minutes and seconds (FREQ/FDM Display) and threshold in dB relative the Reference Level (LEVEL Display).

3-167 To enter the time over which the measurement will be performed, press [TIME] followed by numeric keys to specify MINUTES DIGITS [.] SECONDS DIGITS. To enter threshold press [THRESH] followed by numeric keys to specify threshold in dB relative to reference level. Resolution is 1dB and the Reference level is rounded to the nearest integer.

Note: The [IMP NOISE] key must be illuminated before the [TIME] and [THRESH] keys are operative.

The threshold level corresponds to the rms value of a sinewave for option 015 and to the peak value for option 016.

3-168 The impulse noise measurement will proceed when the [MEAS] key is pressed. During the measurement, the Time Elapsed and the Number of Impulse Counts will appear in the FREQ/FDM Display and the threshold will appear in the LEVEL Display. When the Time Elapsed is equal to the selected Measurement Period, or the count exceeds 999, the Impulse Noise Measurement will terminate. At the end of the measurement, the FREQ/FDM Display will contain elapsed time (equal to selected measurement period unless count exceeds 999 in which case the elapsed time will stop on the 1000th count) and impulse count (max 999). The LEVEL Display will contain the rms value of the last measured signal level.

Note: 1) The required 3746A tuning frequency should be entered before [IMP NOISE] mode is selected. Pressing [FREQ] or [REF] while the 3746A is in the [IMP NOISE] set-up mode (ie, HALTed) will cause it to exit from the [IMP NOISE] mode and permit entry of new frequency or reference data. The [FREQ] key can however be pressed during an actual Impulse Noise measurement (MEAS mode) to display the tuned frequency.

2) Filter selection is automatic. For Option 015 the notched filter [NWT] is selected; for Option 016 the notched [NWT] and weighted [WTD] filters are selected.

3-169 When the measurement is finished and the [HALT] key is illuminated, the set-up mode is again available for redefining the time, or threshold or starting a new measurement.

3-170 Error Conditions: The following error codes may appear in the TEST POINT Display when attempting a phase jitter measurement.

E97 - internal calibration (CAL) signal is outwith limits of +/-2dB from nominal -25dBm level. Impulse noise measurement will not proceed under this condition.

E36 - threshold selected is above +20dBm, the maximum allowable input to the 3746A.

E37 - threshold selected is more than the permitted limit below the input signal level. The limit will be between -54dB and -59dB relative to the input signal level depending on the internal autoranging state of the instrument.

Note: If [MEAS] is pressed with error codes 36 or 37 present the 3746A will exit from the impulse noise measurement into a channel power measurement unless another measurement mode is selected.

3-171 RESET FUNCTION AND NON-VOLATILE MEMORY CLEAR

3-172 Pressing [TR] [CLEAR/SET] initiates a reset sequence which clears all internal registers, including Non-volatile memory and sets the 3746A to a defined state as follows:-

Start, Stop, Step, Reference, Upper, Lower, FDM skips and Random Frequency Registers set to 0. The Frequency Register is set to 1MHz.

FILTER - AUTO and 3.1kHz selected.
TERMINATION - 75 ohm selected.
AVERAGING - resolution of 0.1dB selected (AVE 1).

Upper sideband selected.
Access Switch Test-Point cleared.

Internal Software switches (1-9) described in paragraph 5-60 set to 1.
HP-IB SRQ status = 6 (idle).

The internal GAIN of the 3746A between the 75 ohm input and the rear panel AUDIO OUTPUT is set to minimum.

Note: Because key sequence TR CLR/SET clears all the internal registers, the setting of the rear panel switch bank are lost, making the HP-IB Address 00, and losing all control capabilities. These functions and correct HP-IB addresses can be restored by setting the POWER switch to STBY and then to ON. THe year setting of the internal clock also needs re-setting - see paragraph 3-135.

3-173 HIGH LEVEL SEARCH

3-174 This measurement is basically a frequency SPECTRUM measurement, (the measurement cannot be used in the FDM SCAN mode), which sweeps between an entered START and STOP frequency with a defined STEP size. The maximum STEP size is 3kHz. This is also the optimum STEP size for speed (the measurement always uses the 3.1kHz filter).

3-175 As the instrument tuning is swept between the START and STOP limits the SLMS measures the peak value of signals present at its input. This peak value is compared to the value held in the Upper Limits register. If a peak violation occurs the value of the signal is flashed in the LEVE window and the SLMS proceeds to make an RMS measurement of this signal level. If the RMS value exceeds the threshold set in the Limits register the SLMS will HALT, PRINT or SRQ (depending on which mode of operation is selected). If the RMS value does not exceed the threshold limit the measurement continues.

This measurement should be used in one of the following modes:

1. With the SLMS set to HALT on limits

2. With the SLMS set to PRINT on limits

3. With a remote controller and the SLMS sending an SRQ on limits

Note: The CRT function, and all the functions of the GENERATOR TRACK switch are disabled during the High Level search.

3-176 MEASUREMENT SPEED

3-177 The measurement routine can sweep an 1800 channel baseband in under 20 seconds if no violations occur. The measurement time is increased for each violation detected. Since each violation is checked using part of the SLMS's normal measurement routine, the increase in time depends on the AVEraging mode selected and will be minimal if AVEraging 0 is used.

3-178 FREQ/FDM and LEVEL display

3-179 The measurement speed is too fast to provide a meaningful FDM/FREQ display and hence the display is only refreshed with the current value when a violation in the RMS signal level occurs. The LEVEL display flashes each time a peak violation occurs. When a RMS level violation occurs, if the SLMS is set to HALT on HI LIMITS, the SLMS enters the HALT mode and displays that LEVEL.

3-180 High Level Search with Limit Halt On

3-181 As with all High Level Search measurements, the START STOP and STEP parameters are entered as described for SPECTRUM measurements in paragraph 3-38, 3-39. The UPPER LIMIT and REF registers are set as described in paragraph 3-106 to 3-109.

EXAMPLE: To carry out a high level search between 1MHz and 20MHz to detect violations above -30dBm.

```
Enter [START]  [FREQ]  [1] [0] [0] [0]
Enter [STOP]   [FREQ]  [2] [0] [0] [0] [0]
Enter [STEP]           [3]
Enter [REF]            [4] [0] [-]
Enter [UPPER]          [1] [0]
```

Set LIMITS switch to HI.
Set LIMIT HALT switch to ON
Set all other MODE switches to the left hand position.

To start the measurement press

[SPECT] [UPPER] [MEAS]

The SLMS will make an uninterrupted swept measurement from 1MHz to 20MHz if all the signal levels are below -30dBm. If a violation occurs the SLMS will halt, refresh the FREQ/FDM display, and display the RMS level of the signal causing the violation.

3-182 High Level Search with automatic frequency measurement of the Violating Tone.

3-183 The measurement routine can be altered to include a frequency measurement of the violating tone. This is accomplished by setting the SLMS Frequency Counter ON as outlined by the amended key sequence.

To start the measurement press

[SPECT] [UPPER] [COUNTER] [MEAS]

If the SLMS is set to print on limits the output contains both TUNED frequency and COUNT frequency of the violating tone. The SLMS FREQ/FDM display will show the COUNTER frequency.

Note: When the SLMS is used in the COUNTER mode it makes a frequency count for each RMS threshold violation and this slows down the measurement time.

3-184 High Level Search - Remote Operation

3-185 The High level search can be operated over the HP-IB using a suitable controller. The codes are as follows:

High Level Search SP UL ME

High Level Search
with COUNTER on SP UL CN ME

3-186 LOW LEVEL SEARCH

3-187 This measurement is similar to the High Level Search except the comparison threshold is stored in the Lower Limits register and peak values of signals are compared to this lower limit.

3-188 This mode of operation can only be used when the SLMS is connected (via the HP-IB) to a suitable printer or a suitable controller. The SLMS outputs a printer message, each time a violation occurs, containing the frequency of the violating tone and an OUT statement in the limits column. The level print-out is not a true RMS reading and should not be treated as an absolute reading.

EXAMPLE: To carry out a Low Level search between 1MHz and 20MHz to detect violations below -90dBm.

Enter [START] [FREQ] [1] [0] [0] [0]
[STOP] [FREQ] [2] [5] [0] [0] [0]
[STEP] [3]
[REF] -30
[LOWER] -60

Set LIMITS switch to LO
Set PRINTER to LIM
Set LIMIT HALT to OFF

To start the measurement press,

[SPECT] [LOWER] [MEAS]

For remote operation with a controller send SP LL ME

SECTION

IV

SECTION IV
PERIPHERALS

4-1 INTRODUCTION

4-2 This section of the manual contains information about peripherals which can be used with the SLMS. Suitable peripherals are listed below, but note that this is not necessarily a complete list, other equipment may also be suitable.

20 Column Printer	HP 5150A Opt 001
80 Column Printer	HP 82905A, HP 2631B Opt 046, HP 9871A Opt 001
CRT Display	HP 37461A
Frequency Synthesizers	HP 3330B, HP 3335A, HP 3336A (CCITT), HP 3336B (BELL)
HP-IB Extenders	HP 37201A, HP 37203A
Access Switches	HP 3754A, HP 3756A, HP 3757A
Chart Recorders	HP 680, HP 7155B

4-3 PRINTERS

4-4 The SLMS can be configured to output measurement results to either a 20 or 80 column printer. In both cases the date and the time of the measurement are also sent to the printer.

4-5 Connection of the Printer

4-6 The printers are driven by the SLMS via the HP-IB. This requires that the printer in use be set to a specific listen address and that the SLMS be configured for either a 20 or 80 column printer. Paragraphs 2-39 to 2-49 in Section II contain the information on the settings required.

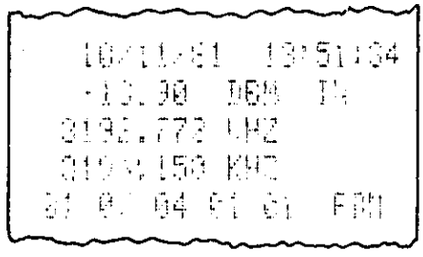
4-7 Printer Switch

4-8 The setting of the front panel PRINTER switch determines which measurement results are printed. In the OFF position none are printed. In the LIMITS position, the SLMS sends a HP-IB message to the printer only when a limit alarm is generated. In the CONTINUOUS position, all measurement results are sent to the printer. In the COMPARISON position, all limit alarm conditions are output on the first sweep, but on successive sweeps, a comparison is made with the previous sweep and only the differences are output to the printer. Typical printed message formats for both the 20 and 80 column printers are shown below. Note that the level is always the absolute level in dBm, irrespective of whether the Level Display is indicating dB or dBm.

80 Column Printer

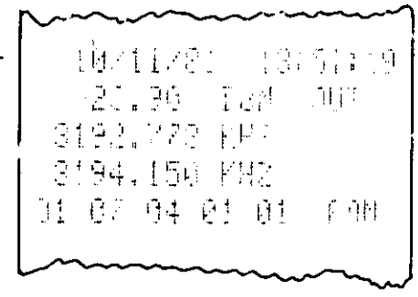
SMG	MG	SG	G	CH	FREQ(KHZ)	COUNT(KHZ)	LEVEL(DBM)	LIMITS	DATE	TIME
01	07	04	01	01	3194.150	3192.784	-23.80	OUT	10/11/81	13:59:00
01	07	04	01	01	3194.150	3192.781	-13.90	WITHIN	10/11/81	13:59:14

20 Column Printer



Date and Time
Absolute Level and Out or In Limits
Counter Frequency
SLMS Frequency
FDM Description

20 Column Printer



4-9 CRT DISPLAY

4-10 The HP 37461A Display has been designed primarily for use with the SLMS. Under SLMS control, up to 256 measurement results can be displayed.

4-11 Connection of the Display

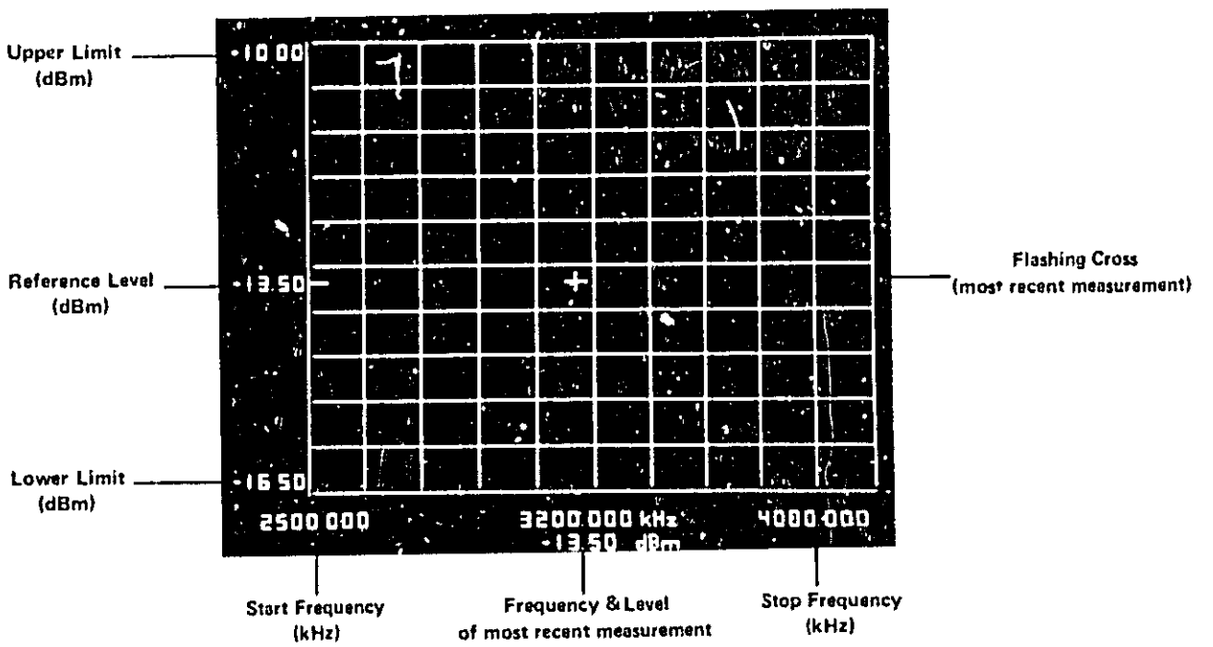
4-12 The Display is driven by the SLMS via the HP-IB. This requires that the Display be set to a specific listen address and that the SLMS rear panel switch be set correctly. Paragraphs 2-39 to 2-49 in Section II contain the information on the settings required.

4-13 Using the Display

4-14 A typical display is shown below. When a measurement is made, both axes are automaticaly scaled and labelled according to, in the case of the X axis the values held in the SLMS Start and Stop Frequency Registers, and in the case of the Y axis, to the absolute level of the values in the Upper and Lower Limit Registers. The values held in the Upper and Lower Limit Registers are dB values relative to the absolute dBm level held in the Reference Level Register. The position of the Reference Level on the Y axis is indicated by a short horizontal line. The frequency and level of the current measurement are displayed alpha-numerically at the centre of the X axis when the SLMS is in the AVEraging 2 mode, or in AVE 0 or 1 when single stepping with the [↑] and [↓] keys.

4-15 As each measurement is made, the corresponding point is plotted on the screen, a flashing cross marking the most recent measurement. Up to 256 points may be displayed on the screen at one time. When the number of points exceeds 256, each new point results in the removal of the earliest point.

4-16 If a measurement is halted at any time, the flashing cross indicates the point at which the sweep was stopped. The [↑] and [↓] keys may then be used to manually step forward and back, using the flashing cross to relate the frequency and level displays to any point on the screen. Providing the contents of the various registers are not altered, the information on the screen will be retained and the sweep resumed from the point at which it was stopped by pressing [MEAS] again. Note that if the [↓] key was the last key pressed, the subsequent sweep will be negative.



4-17 FREQUENCY SYNTHESIZERS

4-18 A Frequency Synthesizer may be used as a tracking generator with the SLMS in two different modes; open loop and bus.

4-19 In the bus mode, a Frequency Synthesizer may be set by the SLMS to a particular level and to track the frequency to which the SLMS is tuned. The SLMS can be set to output the level and frequency information in one of three different formats to suit three particular Frequency Synthesizers; the HP 3330B, HP 3335A, and the HP 3336A/B.

4-20 Connection of the Synthesizers

4-21 In the open loop mode, the only connection between the synthesizer and the SLMS is via the signal path.

4-22 In the bus mode, the synthesizers are driven by the SLMS via the HP-IB. This requires that the synthesizers be set to a specific listen address and that the SLMS be configured for the particular synthesizer being used. Paragraphs 2-39 to 2-49 in Section II contain the information on the settings required.

4-23 Generator Tracking – Open Loop

4-24 In the O/LP (open loop) position of the GEN TRACK switch, there is no HP-IB control of the synthesizer and so the synthesizer must be set to step through the same sequence of frequencies as the SLMS, slowly enough (approximately one frequency change per second) for the SLMS to make a valid measurement at each frequency. Refer to Section III Paragraph 3-121.

4-25 Generator Tracking – Bus

4-26 In the STABility and LIMits positions of the GEN TRACK switch, each time the SLMS tunes to a new frequency, it outputs a suitable HP-IB message to retune the synthesizer. Various criteria (details will be found in Section III Paragraphs 3-119 through 3-120) must be met before the SLMS can retune to a new frequency.

4-27 Setting the Synthesizer Output Level

4-28 When connected via the HP-IB, the output level of the synthesizer can be set to the value held in the Reference Level Register of the SLMS by the key sequence [TR] [dB/dBm]. (The key sequence [TR] [dB/dBm] [MEAS] initiates an 'equalization cycle', details of which will be found in Section III Paragraphs 3-126.

4-29 HP-IB EXTENDERS

4-30 HP-IB Extenders can be used with the SLMS to allow control of a CRT, synthesizer or printer in a remote location, but note that in the case of the HP 37203A Extender, the SLMS rear panel HP-IB Extender switch must be in the OFF position. If the HP 37201A is being used then the SLMS rear panel HP-IB Extender switch must be in the ON position which causes the SLMS to serial-poll the local 37201A when it sees 'SRQ' asserted. Inside the local 37201A the 'SRQ on string sent' switch must be set to the ON position which instructs the 37201A to SRQ when it has successfully transmitted the message string to the remote Extender. Full details of the 37201A operation with the SLMS will be found in Section V Paragraph 5-27.

4-31 ACCESS SWITCHES

4-32 The SLMS is capable of controlling up to 111 Access Switches (HP Models 3754A, 3756A and 3757A) giving access to up to 1000 test points. All models are controlled at the first level via a 2-wire control output on the SLMS rear panel. Subsequent levels may be controlled via the 2-wire control path or in the case of the HP 3754A and HP 3757A via the coaxial cable carrying the RF signal. Details of how to select Access Switch Test Points will be found in Section III Paragraph 3-148.

4-33 Connection of Access Switches

4-34 Details of how to connect Access Switches will be found in Section III Paragraph 3-145 and in the individual Access Switch Manuals. A +/-15Vdc power supply is provided on the SLMS rear panel to power one 3757A Access Switch.

4-35 CHART RECORDER

4-36 The SLMS can provide either a current or voltage drive to a Chart Recorder. The output, 0 to +5mA for current drive or -3 to +3Vdc for voltage drive, which corresponds to a measured dynamic range of +/-3dB, is available on the SLMS rear panel. Selection of current or voltage drive is by an internal switch and link, refer to Section II Paragraph 2-32.

4-37 To activate the Chart Recorder Output, press [TR] [REF] [TR] [MEAS]. The output is set by using the most level recent measurement as the centre of the dynamic range (approximately 0V or +2.5mA). Any change in level on subsequent measurements will result in a corresponding change in the Chart Recorder Output, provided it is within the +/-3dB dynamic range.

4-38 If measurements fall outside the dynamic range, or it is required to centre the dynamic range on a new level, then the key sequence [TR] [REF] [TR] [MEAS] can be used at any time to re-centre the output.

Note: The Chart Recorder facility can only be used when making single frequency level measurements (e.g. monitoring a pilot tone) and cannot be used for Spectrum or Scan measurements.

SECTION

V

SECTION 5

HEWLETT-PACKARD INTERFACE BUS

5-1 INTRODUCTION

5-2 This section contains information and instructions on the use of the 3746A Selective Level Measurement Set (SLMS) with the Hewlett-Packard Interface Bus (HP-IB).

5-3 The HP-IB is Hewlett-Packard's implementation of the IEEE Standard 488-1978 (Digital Interface For Programmable Instrumentation). This standard defines a physical interface and protocol which enables the remote control of instrumentation systems.

5-4 The information in this section is divided up into two main sub-sections.

1. Paragraphs 5-7 to 5-29 describe the 3746A SLMS capabilities when it is configured as the system controller.

2. Paragraphs 5-30 to 5-89 describe the 3746A SLMS capabilities when it is configured to be under the remote control of a system controller (normally a computer or computing controller).

5-5 INSTALLATION

5-6 Installation of the SLMS into an HP-IB system is separately covered in the installation section of this manual.

5-7 HP-IB OPERATION – SLMS AS SYSTEM CONTROLLER

5-8 The SLMS configured as the system controller has the ability to control a Printer, Synthesizer, CRT Display and HP-IB Extender. The operation of the SLMS (when it is the system controller) with these peripherals is described in Section IV Peripherals. The following paragraphs describe the format of the various messages used by the SLMS when it is the system controller.

5-9 HP-IB COMPATIBILITY

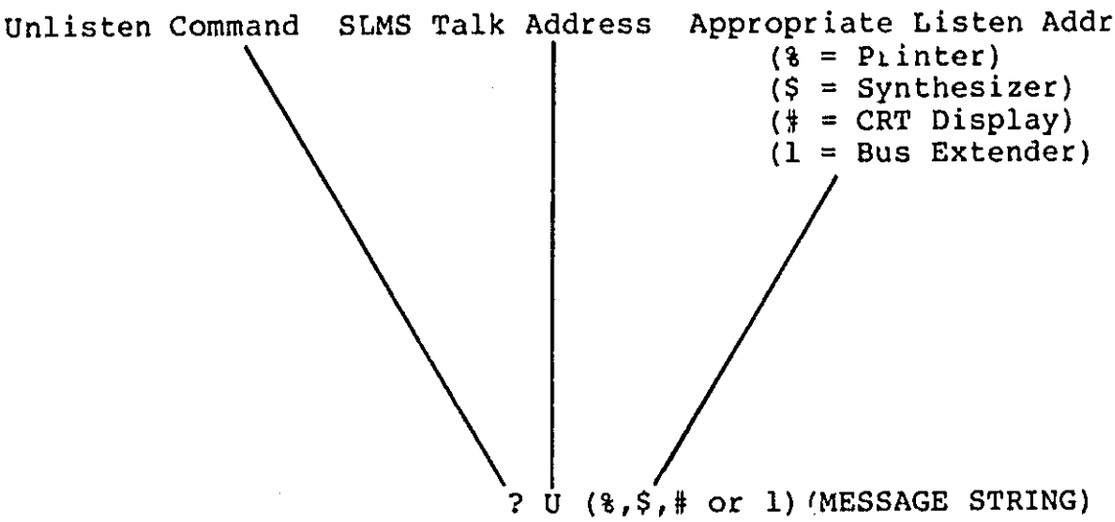
5-10 When the SLMS is configured as the system controller it has the following HP-IB compatibility as defined in the IEEE Standard 488-1978.

SH1,AH1,T4,L4,SR0,RL0,PP0,DC0,DT0,C1,C3,C4,C28

Note: It is not necessary to have a knowledge of these compatibility mnemomics to understand the operation of the SLMS. They are included to give people familiar with IEEE standard 488-1978 an immediate overview of the SLMS capability

5-11 HP-IB MESSAGE FORMATS

5-12 The message formats used by the SLMS to send data to peripherals under its control is given in the following paragraphs. Before each message string the SLMS sends the ASCII address information shown below;



5-13 PRINTER

5-14 The printer message is formatted for either an 80 column or 20 column printer depending upon the setting of a switch in the rear panel HP-IB switch bank. See Installation Section, Figure 2-5.

5-15 Printer Message — 80 Column Format

5-16 With 80 column format selected a header is printed before the first measurement in a new measurement sequence, eg if SPECT, MEAS is pressed the header is printed. Subsequently pressing HALT to stop the measurement and then CONT to restart the measurement will not cause a new header to be printed. The header format is illustrated in Figure 5-1.

5-17 Measurement results are transmitted to the 80 column printer in the format illustrated in Figure 5-2.

5-18 For the optional phase jittter and impulse noise measurements the format of messages sent to the 80 column printer are illustrated in Figures 5-3 and 5-4.

```
HP-3746#SLMS#Test#Point# PPP (CR)(LF)
Ref.#Level#(L)(L)(L)L.LL dBm##Upper Limit#(L)(L)(L)L.LL dBm#
#Lower#Limit#(L)(L)(L)L.LLdBm (CR)(LF)
(CR)(LF)
SMG#HG#SG##G#CH#FREQ(kHz)##COUNT(kHz)#####
    M
LEVEL###LIMITS###DATE#####(CR)(LF)
```

Figure 5-1 80 Column Printer Message Header for CCITT Plan

Where: (CR) = Carriage Return
(LF) = Line Feed
# = Space
PPP = Test Point Number

Note: 1. FOR BELL PLANS SMG is replaced by ###.

2. (L) indicates optional level digit, e.g. maximal case is -120.00 and minimal case is 5.00. If this message format is to be read by an external controller, it is recommended that the header characters be entered into a string variable to allow for floating numberic formats.

3. All codes are transmitted as ASCII characters.

4. The SLMS sets the HP-IB signal line EOI true, while the last character is being transmitted, to indicate end of message.

```
#JJ####SS#GG#CC##FFFFF.FFF#####fffff.fff###LLLL.LLdBm####WITHIN#DD/MM/YY
##HH:MM:SS(CR)(LF)                                              #OUT##
```

(a) Message format for all CCITT Plans.

```
####HH#SS#GG#CC#FFFFF.FFF#####fffff.fff##LLLL.LL##WITHIN###DD/MM/YY##HH:MM:SS
(CR)(LF)                                              ###OUT
```

(b) Message format for all BELL Plans.

Figure 5-2 80 Column Printer Measurement Format

Where:
JJ = Supermastergroup
HH = Hyper/Mastergroup
SS = Supergroup
GG = Group
CC = Channel
FFFFF.FFF = Tuned Frequency
fffff.fff = Counter Frequency
LLLL.LL = Level Measurement
# = Space
(LF) = Line Feed
(CR) = Carriage Return

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement will be replaced by spaces; eg if non-FDM measurements are being made then no FDM data will be sent.
4. Leading zeros in the frequency and level data will be replaced by spaces.
5. If the level measurement is a negative value, a - sign will precede the level measurement.
6. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

```
HP-3746#SLMS#Test#Point# PPP (CR)(LF)
Ref.#Level#(L)(L)(L)L.LL dBm##Upper Limit#(L)(L)(L)L.LL dBm#
#Lower#Limit#(L)(L)(L)L.LLdBm (CR)(LF)
(CR)(LF)
SMG#MG
SMG#HG    #SG##G#CH#FREQ(kHz)##JITTER(DEG)###DATE######TIME
####MG
(CR)(LF)
(CR)(LF)
```

Header

```
#JJ#
    HH#SS#GG#CC#fffff.fff######zz.zz###DD/MM/YY##HH:MM:SS
####
(CR)(LF)
```

Measurement

Where:

JJ	= Supermastergroup	fffff.fff	= Measurement Frequency
HH	= Hyper/Mastergroup	zz.zz	= Jitter Measurement
SS	= Supergroup	#	= Space
GG	= Group	(LF)	= Line Feed
CC	= Channel	(CR)	= Carriage Return
PPP	= Test Point Number		

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement are replaced by spaces; eg if non-FDM measurements are being made then no FDM data will be sent.
4. Leading zeros in the frequency and jitter data will be replaced by spaces.
5. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-3 80 Column Printer Phase Jitter Measurement Messages

```
HP-3746#SLMS#Test#Point# PPP (CR)(LF)
Ref.#Level#(L)(L)(L)L.LL dBm##Upper Limit#(L)(L)(L)L.LL dBm#
#Lower#Limit#(L)(L)(L)L.LLdBm (CR)(LF)
(CR)(LF)
SMG#M
SMG#HG      #SG##G#CH#FREQ(kHz)##TRHESHOLD(DB)#TIME##COUNT###
####MG      DATE#####TIME
(CR)(LF)
(CR)(LF)
```

Header

```
#JJ#HH#SS#GG#CC#fffff.fff##TTTT.TT#####mm:ss##NNNN###DD/MM/YY
##HH:MM:SS (CR)(LF)
```

Measurement

Where:

JJ = Supermastergroup	fffff.fff = Measurement Frequency
HH = Hyper/Mastergroup	TTTT.TT = Threshold Level
SS = Supergroup	NNNN = Impulse Noise Count
GG = Group	mm.ss = Count Time (minutes:seconds)
CC = Channel	# = Space
(LF) = Line Feed	(CR) = Carriage Return
PPP = Test Point Measurement	

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement will be replaced by spaces; eg if non-FDM measurements are being made then no FDM data will be sent.
4. Leading zeros in the frequency and threshold data will be replaced by spaces.
5. If the threshold level is a negative value, a - sign will precede the threshold level.
6. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-4 80 Column Printer Impulse Noise Measurement Format

5-19 Printer Message – 20 Column Format

5-20 With the rear panel printer format switch set for 20 column format the message transmitted to the printer is illustrated in Figure 5-3 for the standard SLMS measurements, and in Figures 5-6 and 5-7 for the optional phase jitter and impulse noise measurements respectively.

```
                    (LF)
                    (LF)
                    JJ#MM#SS#GG#CC##FDM#(LF)
                    FFFFF.FFF#KH2#######(LF)
                    fffff.fff#KHz#######(LF)
                   #LLLL.LL##DBM## IN ###(LF)
                                 OUT
                    DD/MM/YY##HH:MM:SS##(LF)

Where:  JJ = Supermastergroup     FFFFF.FFF = Counter Frequency
        HH = Hyper/Mastergroup    fffff.fff = Measurement Frequency
        SS = Supergroup             LLLL.LL = Level Measurement
        GG = Group                        # = Space
        CC = Channel                  (LF) = Line Feed

           DD/MM/YY = Date as Day/Month/Year
           HH:MM:SS = Time as Hours:Minutes:Seconds

Notes: 1. All characters are transmitted as ASCII codes.

       2. The SLMS sets the HP-IB signal line EOI true while the last
          character is being transmitted to indicate end of string.

       3. Lines containing information not defined in the current
          measurement will not be transmitted; eg in broadband power
          measurements only the lines containing  level and date/time
          information will be transmitted to the printer.

       4. Leading blanks in frequency and level data will be replaced
          by spaces.

       5. If the level measurement is a negative value, a - sign will
          precede the level measurement.

       6. FDM levels are all transmitted as 2 digit numbers with leading
          zeros where appropriate. FDM levels not defined in the current
          plan will be replaced by spaces.
```

Figure 5-5 20 Column Printer Message Format

```
                    (LF)
                    (LF)
                    JJ#MM#SS#GG#CC##FDM#(LF)
                    fffff.fff#KHz#######(LF)
                    ###22.22#DEGREES P/P(LF)
                    DD/MM/YY##HH:MM:SS##(LF)

Where: JJ = Supermasterrgroup   fffff.fff = Measurement Frequency
       HH = Hyper/Mastergroup       22.22 = Jitter Measurement
       SS = Supergroup                  # = Space
       GG = Group                    (LF) = Line Feed
       CC = Channel

          DD/MM/YY = Date as Day/Month/Year
          HH:MM:SS = Time as Hours:Minutes:Seconds

Notes: 1. All characters are transmitted as ASCII codes.

       2. The SLMS sets the HP-IB signal line EOI true while the
          last character is being transmitted to indicate end of
          string.

       3. Lines containing information not defined in the current
          measurement will not be transmitted; eg in broadband
          power measurements only the lines containing  level and
          date/time information will be transmitted to the
          printer.

       4. Leading blanks in frequency and jitter data will be
          replaced by spaces.

       5. FDM levels are all transmitted as 2 digit numbers with
          leading zeros where appropriate. FDM levels not defined
          in the current FDM plan will be replaced by spaces.
```

Figure 5-6 20 Column Printer Phase Jitter Measurement Format

```
                    (LF)
                    (LF)
                    JJ#MM#SS#GG#CC##FDM#(LF)
                    fffff.fff#KHz#######(LF)
                    #TTTT.TT#DB#(THRESH)(LF)
                    NNN#COUNT TIME#mm:ss(LF)
                    DD/MM/YY##HH:MM:SS##(LF)

Where: JJ = Supermastergroup fffff.fff = Measurement Frequency
       HH = Hyper/Mastergroup  TTTT.TT = Threshold Level
       SS = Supergroup              NNN = Impulse Count
       GG = Group                 mm:ss = Count Time (minutes:seconds)
       CC = Channel                   # = Space
                                   (LF) = Line Feed

           DD/MM/YY = Date as Day/Month/Year
           HH:MM:SS = Time as Hours:Minutes:Seconds

Notes: 1. All characters are transmitted as ASCII codes.

       2. The SLMS sets the HP-IB signal line EOI true while the last
          character is being transmitted to indicate end of string.

       3. Lines containing information not defined in the current
          measurement will not be transmitted; eg in non-FDM
          measurements the line containing FDM data will not be
          transmitted to the printer.

       4. Leading blanks in frequency and threshold level data will
          be replaced by spaces.

       5. If the threshold level is a negative value, a - sign will
          precede the threshold level.

       6. FDM levels are all transmitted as 2 digit numbers with
          leading zeros where appropriate. FDM levels not defined in
          the current plan will be replaced by spaces.
```

Figure 5-7 20 Column Printer Impulse Noise Measurement Format

5-21 FREQUENCY SYNTHESIZER

5-22 The Synthesizer message format is determined by the setting of two switches in the HP-IB switch bank. See Installation Section Figure 2-5 for details. The message formats are defined in Figure 5-8.

Message Number	Suitable for Synthesizer	Message Format	
		Frequency	Level
1	HP3330B	Lfffff.fff>(CR)(LF)	NLLLL.LL;(CR)(LF)
2	HP3335A	FFffffff.fffKH(CR)(LF)	ALLLL.LLK(CR)(LF)
3	HP3336A	FFffffff.fffKH(CR)(LF)	AMLLLL.LLDB(CR)(LF)
4	HP3336A	FFffffff.fffKH(CR)(LF)	AMLLLL.LLDB(CR)(LF)

Where : fffff.fff = Synthesizer tuning frequency in kHz
LLLL.LL = Synthesizer output amplitude in dBm
(CR) = Carriage Return
(LF) = Line Feed

Notes: 1. All characters are transmitted as ASCII codes

2. The frequency and level messages are sent independently, and the level message is not transmitted unless requested by the TR dB/dBm key sequence

3. The SLMS sets the signal line EOI true while the last character in a message is being transmitted to indicate end of message.

4. Leading zeros in the frequency and amplitude data are not transmitted.

5. Negative amplitude data is preceded by a - sign.

Figure 5-8 Frequency Synthesizer Message Formats

5-23 CRT DISPLAY

5-24 The SLMS messages to a CRT Display are enabled by the selection of a switch in the HP-IB switch bank. See Section II Installation for details.

5-25 CRT Display Message Formats

5-26 At the start of each Scan or Spectrum measurement sequence, the SLMS sends 5 strings, as shown in Figure 5-9, defining the current reference level, the upper limit level, the lower limit level, the content of the upper frequency register and the content of the lower frequency register. The strings defining the upper and lower limit levels are sent as absolute values in dBm (and not as dB values relative to the reference level).

String Number	Defines	Format
1	Upper Limit	ULLLL.LL(CR)(LF)
2	Lower Limit	LLLLL.LL(CR)(LF)
3	Reference Level	RLLLL.LL(CR)(LF)
4	Start Frequency	Bffffff.fff(CR)(LF)
5	Stop Frequency	Effffff.fff(CR)(LF)

Where: LLLL.LL is the appropriate level value
ffff.fff is the appropriate frequency value

Notes:
1. All characters are transmitted as ASCII codes.
2. The five strings are sent as a single message and the SLMS sets the HP-IB signal line EOI ttrue while the last character is being transmitted to signal end of message.
3. Leading zeros are not transmitted.
4. Negative amplitude data is preceded by a - sign

Figure 5-9 CRT Display Initial Message

5-27 Measurement points for display are sent to the CRT in one of two formats depending upon the currently defined averaging setting. Figure 5-10 illustrates the format of the messages.

Message No.	Defines	Message Format	
		Averaging 0 and 1	Averaging 2
1	Frequency	Xnn(CR)(LF)	Fffffff.fff(CR)(LF)
2	Level	Ynn(CR)(LF)	ALLLL.LL(CR)(LF)

Where: fffff.fff = frequency in kHz
LLLL.LL = amplitude in dBm
nn = the co-ordinate value coded as a hexidecimal number

Notes: 1. All characters are transmitted as ASCII codes

2. The frequency and level messages are sent independently and immediately they are avaliable. They may be seperated by messages sent to other HP-IB devices.

3. The SLMS sets the HP-IB signal line EOI true while the last character in each message is being sent to indicate end of message.

4. Leading zeros are not transmitted

5. Negative amplitude data is preceded by a - sign

Figure 5-10 CRT Display Message Formats

5-28 HP-IB EXTENDER

5-29 If the SLMS rear panel HP-IB switch bank is set to indicate that a HP 37201A HP-IB Extender is in the HP-IB system, the SLMS will await confirmation from the HP-IB Extender after outputting each message string that the bus extender has completed transmission of the message to the remote HP-IB Extender. Figure 5-11 illustrates the sequence followed each time the SLMS outputs a message on the HP-IB.

Note: If the HP-IB Extender used does not respond to the SLMS messages as illustrated in Figure 5-11 then the SLMS will hang-up.

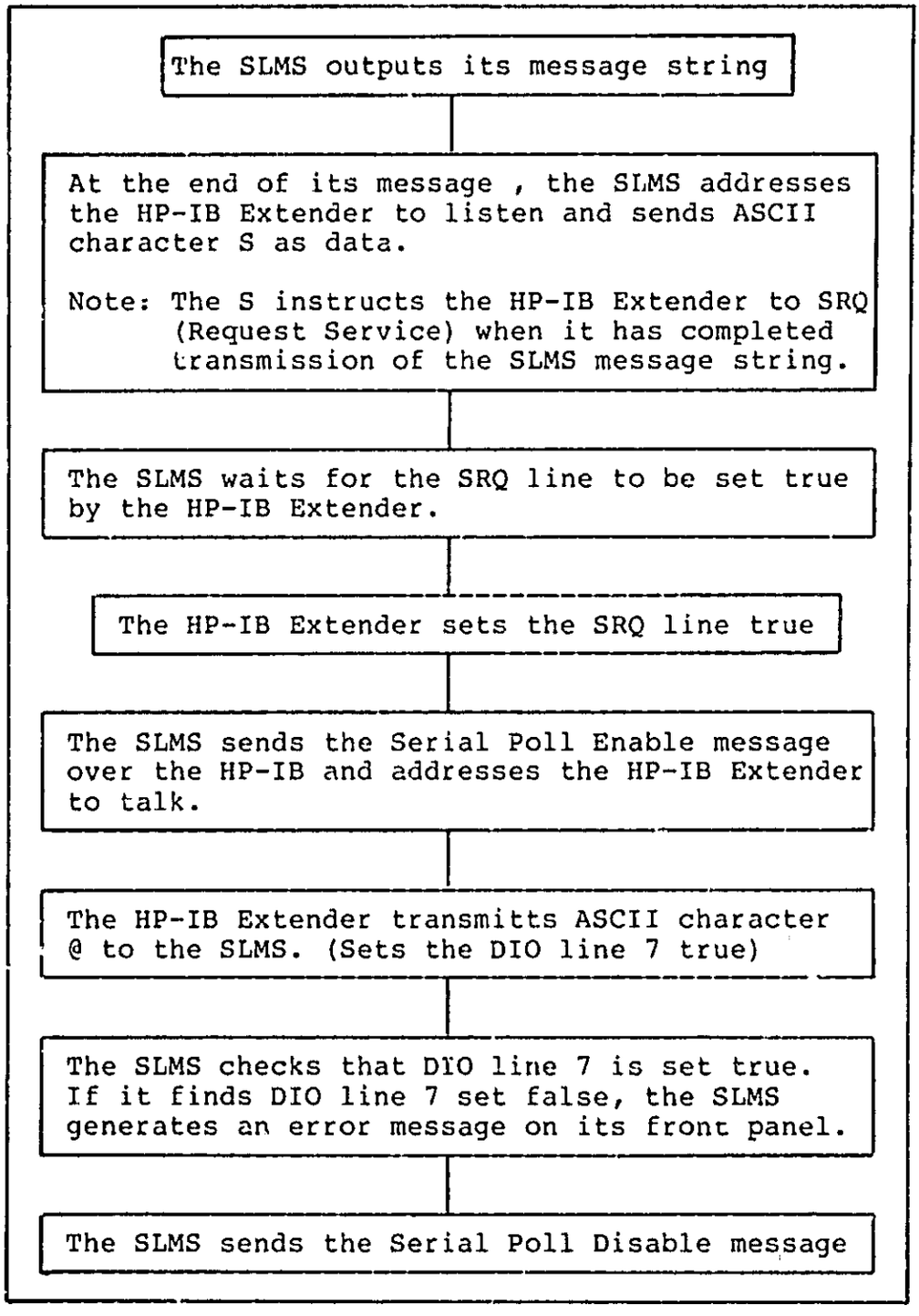


Figure 5 -1 SLMS/HP-IB Extender Operation

5-30 HP-IB OPERATION – SLMS AS DEVICE

5-31 The SLMS configured as an HP-IB Device has no control ability. It can be controlled remotely by a system controller sending the appropriate control sequences over the HP-IB and also may be instructed to transmit the results of its measurements over the HP-IB.

5-32 HP-IB COMPATIBILITY

5-33 When the SLMS is configured as a device under the remote control of a separate system controller it has the following HP-IB compatibility as defined in the IEEE Standard 488-1978.

SH1,AH1,T6,L4,SR1,RL1,PP0,DC1,DT1,C0

Note: It is not necessary to have a knowledge of these compatibility mnemomics to understand the operation of the SLMS. They are included to give people familiar with IEEE standard 488-1978 an immediate overview of the SLMS capability

5-34 PROGRAMMING CODES FOR THE SLMS

5-35 FRONT PANEL PUSHBUTTON KEYCODES

5-36 The programming codes listed in Table 5-1 sent as data over the HP-IB to the SLMS will produce the same effect as pressing the corresponding key in manual operation.

Table 5-1 Front Panel Keycodes

Key	Programming Code		
	ASCII	Octal	Decimal
TERMINATION 75ohm	T1	124,061	84,49
TERMINATION 150ohm	T2	124,062	84,50
TERMINATION 600ohm	T3	124,063	84,51
FILTER AUTO	AF	101,106	65,70
FILTER 48kHz	GF	107,106	71,70
FILTER 3.1kHz	CF	103,106	67,70
FILTER 38Hz	PF	120,106	80,70
FILTER WTD	WF	127,106	87,70
REFerence Level	RL	122,114	82,76
UPPER Limit	UL	125,114	85,76
LOWER Limit	LL	114,114	76,76
START	SR	123,122	83,82
STOP	ST	123,124	83,84
STEP	SE	123,105	83,69
FREQuency	FR	106,122	70,82

Table 5-1 Front Panel Keycodes (continued)

Key	Programming Code		
	ASCII	Octal	Decimal
SCAN	SC	123,103	83,67
SPECTrum	SP	123,120	83,80
MEASure	ME	115,105	77,69
HALT	HA	110,101	72,65
SG/GP POWER	FP	106,120	70,80
I/P POWER	IP	111,120	73,80
NS PILOT	NP	116,120	78,80
1	1	061	49
2	2	062	50
3	3	063	51
4	4	064	52
5	5	065	53
6	6	066	54
7	7	067	55
8	8	070	56
9	9	071	57
0	0	072	58
.	.	056	46
+ "up arrow"	+	053	43
- "down arrow"	-	055	45
TRansfer	TR	124,122	84,82
CLEAR/SET	AC	101,103	68,67
COUNTER	CN	103,116	67,78
Any FDM key (CH,G,SG etc)*	FM	106,115	70,77
IMPulse NOISE	IM	111,115	73,77
TIME/O JITTER	PJ	120,112	80,74
THRESHold/NWT	NF	116,106	78,70
AVErage	AV	101,126	65,86
GAIN	GN	107,116	71,78
LOCAL	LO	114,117	76,79

*Note: The entry of FDM plan modifiers (see paragraph 3-99) is a special case requiring an additional programming code, "FM". For example, when entering a supergroup modifiers value of 1, the manual key sequence would be TR SG SG 1. For remote programming the following codes should be sent TR FM SG 1.

5-37 The programming codes listed in Table 5-2 are operated in a different manner from the corresponding keys in manual mode.

Table 5-2 Altered Front Panel Keycodes

Key	Programming Code		
	ASCII	Octal	Decimal
*SMG	SM	123,115	83,77
*HG/MG	MG	115,107	77,71
*SG	SG	123,107	83,71
*G	GR	107,122	71,82
*CH	CH	103,110	67,72
+dB/dBm (display dB)	DB	104,102	68,66
+dB/dBm (display dBm)	DM	104,115	68,77
+FREQ/FDM (display FREQ)	DQ	104,121	68,81
+FREQ/FDM (display FDM)	DF	104,106	68,70

Notes:
1. If the FREQ/FDM display is in the FREQ mode and the instrument is being manually operated, it is necessary to press the first FDM entry key twice. The first press changes the display to the FDM mode, the second press allows the entry. During remote operation to avoid sending double key codes, special key codes are assigned , as shown in Table 5-2.
2. The dB/dBm and FREQ/FDM front panel keys operate in a toggle mode. To avoid confusion in remote operation, separate codes are given for each function. In cases where these keys are used for purposes other than toggling the appropriate display (for example the key sequence TR dB/dBm used to output the reference level to a frequency synthesizer) either code may be used.

5-38 INTERNAL KEYCODES

5-39 In addition to the front panel keys, an SLMS controlled via the HP-IB effectively has additional keys that can be operated by transmitting the keycodes listed in Table 5-3. The operation of these keycodes is explained in paragraphs 5-42 through 5-56.

Table 5-3 SLMS Internal Keycodes

Function	Programming Code		
	ASCII	Octal	Decimal
Set Years Register	YR	131,122	89,82
Set Months Register	MH	115,110	77,72
Set Days Register	DY	104,131	68,89
Set Hours Register	HR	110,122	72,82
Set Minutes Register	MN	115,116	77,78
CRT Display Disable	CR0	103,122,060	67,82,48
CRT Display Enable	CR1	103,122,061	67,82,49
Print	PR	120,122	80,82
Start Random Frequency Load	RF	122,106	82,70
Stop Random Frequency Load	KH	113,110	75,72
Auto Untalk Off	AU0	101,125,060	65,85,48
Auto Untalk On	AU1	101,125,061	65,85,49
Calibrate	CL	103,104	67,76
Load Equalization Coefficents	EQ	105,121	69,81
Skip FDM Descriptions	SK	123,113	83,75

5-40 Setting Time/Date

5-41 Upon the receipt of any of the set time/date codes the internal SLMS clock is stopped, the seconds register cleared to zero and the SLMS enters the display/load time/date mode. Transmission of a time or date keycode followed by up to 2 numeric keycodes will set the specified register. In this mode, the START and STOP keycodes can be used to start and stop the clock. Transmission of any other keycode will start the SLMS internal clock and return the SLMS to its normal mode.

5-42 CRT Disable/Enable

5-43 These codes disable or enable the SLMS's ability to send HP-IB messages to an HP 37461A CRT Display.

5-44 Print

5-45 This code instructs the SLMS to transmit its printer message. The SLMS must be addressed to talk with its talk address 1 after receiving this command. If the SLMS receives the print command and is not addressed to talk it will request service (set SRQ true). If the print command is received when the SLMS is in the measurement mode it will cause the SLMS to revert to the halt mode.

5-46 Auto Untalk On/Off

5-47 With Auto Untalk enabled the SLMS will automatically untalk itself after sending a message over the bus. Before the SLMS can transmit another message it requires to be sent its talk address again. With Auto Untalk disabled the SLMS will stay in the talk mode until the system controller either sends it its listen address or addresses another device to talk.

5-48 Calibrate

5-49 The calibrate code instructs the SLMS to perform a calibration cycle before the next measurement. Normally the SLMS performs a calibration cycle each time a new measurement sequence is defined and then repeats this calibration at 10 minute intervals.

5-50 Load Equalization Coefficents

5-51 This code allows the equalization coefficents register to be loaded with data supplied by the system controller. The equalization coeficent register is used by the SLMS in equalized mode to apply a correction factor to level measurements. See Section 3 of this manual for a description of equalized sweep measurements.

5-52 The equalization coeficent register contains 32 level values (in dB), which are used to modify the measured level values when the SLMS is in the equalized mode. The 1st level value stored is added to level measurements made in the range 0 to 0.999999MHz to give the equalized value, the 2nd value is added to measurements in the range 1 to 1.999999MHz etc up to the 32nd value which is applied to measurements in the range 31 to 31.999999MHz.

5-53 After sending the load equalization coeficent code (EQ) the level values are sent using the numeric and decimal point keycodes.Each value must be suffixed with the ASCII characters DM as illustrated below.

EQ(1st value)DM(2nd value)DM.....(32nd value)DM

5-54 The loading of the equalization coefficent register will be terminated when the 32nd value is loaded or whenever another remote command is received. Register values not defined on the current loading will retain their previous values.

5-55 FDM Skips

5-56 The 3746A can be programmed to "skip" or bypass parts of an FDM plan that are of no interest. Up to 30 sections of the plan can be loaded into the FDM skip registers. Under external control, skips are loaded into these registers using the command "SK" followed by a suffix of a multiple of 4 digits containing the FDM description. Each group of 4 digits is constructed as follows:

abcd, where a = supermastergroup number (1 digit)
b = hypergroup or mastergroup number (1 digit)
cd = supergroup number (2 digits, leading zero required if applicable)

The command is automatically terminated on receipt of any non-numeric data. No additional terminator is required.

5-57 SLMS FRONT PANEL SWITCH SETTING

5-58 The SLMS front panel switch settings can be controlled over the HP-IB by transmitting the ASCII characters SW followed by two numeric keycodes. The first keycode defines the switch and the second keycode defines the switch position. See example below.

Example: The ASCII characters SW32 set switch 3 to position 2

5-59 The SLMS front panel switch codes are listed in Table 5-4.

Table 5-4 SLMS Front Panel Switch Codes

Front Panel Switch	Switch Select Code	Switch Position Code			
		1	2	3	4
PLAN Switches					
(Bell/CCITT)	1	Bell U600	Bell L600	CCITT	-
1A / 2 / 1B	2	MMX1 / 1A	MMX2 / 2	1B	-
SYSTEM BW	3	4MHz	6MHz	8MHz	12MHz
PILOT	4	84	104	VC	NS
MODE Switches					
GEN TRACK	5	OFF	STAB	LIM	O/L?
MEASUREMENT	6	CONT	SINGLE	-	-
LIMIT HALT	7	OFF	ON	-	-
LIMITS	8	OFF	LO	HI	BOTH
PRINTER	9	OFF	LIM	CONT	COMP

5-60 SLMS INTERNAL SWITCH SETTING

5-61 In addition to the front panel switches the SLMS has effectively 4 internal switches which may only be accessed via the HP-IB. Internal switch settings are defined by transmitting the ASCII characters IS followed by two numeric keycodes. The first keycode defines the internal switch (1 to 4) and the second keycode defines the switch position (1 to 9). See example below.

Example: ASCII characters IS17 sets internal switch 1 to position 7

5-62 The SLMS internal switch codes are listed in Table 5-5 and their operation is explained in paragraphs 5-63 through 5-68.

Table 5-5 SLMS Internal Switches

Internal Switch	Function
1	Measurement Message Format
2	Synthesizer Message Format
3	FDM Plan Selection
4	Limit Comparison Store Clearing

5-63 Internal Switch 1 — Measurement Message Format

5-64 Internal Switch 1 determines the format of the measurement message transmitted by the SLMS in response to the print keycode (PR) or the setting of the front panel PRINT switch. The SLMS requires to be addressed to talk with its talk address 1 to output these messages. The SLMS will request service (SRQ) each time it requires to talk and will indicate when serial polled which of its talk addresses is required.

5-65 Figure 5-12 illustrates the Measurement Message format. When the optional phase jitter and impulse noise measurements are selected the message format changes as shown in Figure 5-13.

Switch Position	Message Description	Message Format
1	Same as the 20 column printer message sent by the SLMS as system controller.	See Figure 5-5
2	FDM,Frequency,Level, Limits.	JJHHSSGGCCfffff.ffffFFFF.FFFLLLL.LLY(CR)(LF) N
3	Frequency,Level,Limits	fffff.ffffFFFF.FFFLLLL.LLY(CR)(LF) N
4	Level, Limits	LLLL.LLY(CR)(LF) N
5	Error Code	EE(CR)(LF)
6	Unused Position	(CR)(LF)
7	Same as the 80 column printer message sent by the SLMS as system controller.	See Figures 5-1 and 5-2
8	Date and Time	DD/MM/YY#HH:MM:SS(CR)(LF)
9	Unused position	(CR)(LF)

Where: JJ = Supermastergroup
HH = Hyper/Mastergroup
SS = Supergroup
GG = Group
CC = Channel
EE = Error Code
DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds
FFFFF.FFF = Counter Frequency
fffff.fff = Measurement Frequency
LLLL.LL = Level Measurement
# = Space
(LF) = Line Feed
(CR) = Carriage Return
Y = (within limits)
N = (outwith limits)

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement will not be transmitted; eg if non-FDM measurements are being made no FDM data will be sent.
4. Leading zeros in the frequency and level data will be replaced by spaces.
5. If the level measurement is a negative value, a - sign will precede the level measurement.
6. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-12 Internal Switch 1 Settings

Switch Position	Message Description	Message Format
1	Same as the 20 column printer message sent by the SLMS as system controller.	See Figure 5-6 for Phase Jitter See Figure 5-7 for Impulse Noise
2	FDM, Frequency, Jitter	JJHHSSGGCCfffff.fff##ZZ.ZZY(CR)(LF) N
2	FDM, Frequency, Impulse Noise	JJHHSSGGCCfffff.fffTTTT.TTNNNNmm:ss(CR)(LF)
3	Frequency, Jitter	fffff.fff##ZZ.ZZY(CR)(LF) N
3	Frequency, Impulse Noise	fffff.fffTTTT.TTNNNNmm:ss(CR)(LF)
7	Same as the 80 column printer message sent by the SLMS as system controller.	See Figure 5-3 for Phase Jitter See Figure 5-4 for Impulse Noise

Where: JJ = Supermastergroup
HH = Hyper/Mastergroup
SS = Supergroup
GG = Group
CC = Channel
fffff.fff = Measurement Frequency
TTTT.TT = Threshold Level
ZZ.ZZ = Jitter Measurement
NNNN = Impulse Count
mm:ss = Count Time (minute:seconds)
= Space
(LF) = Line Feed
(CR) = Carriage Return

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement will not be transmitted; eg if non-FDM measurements are being made no FDM data will be sent.
4. Leading zeros in the frequency and level data will be replaced by spaces.
5. If the threshold level is a negative value, a - sign will precede the threshold level.
6. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-13 Internal Switch 1 Phase Jitter and Impulse Measurement Formats

5-66 Internal Switch

5-67 Internal Switch 2 determines the format of messages sent to a frequency synthesizer as detailed in Figure 5-14.The SLMS requires to be addressed to talk with its Talk Address No 2 to output these messages. The SLMS will request service (SRQ) each time it requires to talk and will indicate when serial polled which of its talk address is required.

Switch Position	Message Description	Message Format	
		Level	Frequency
1	Format suitable for HP 3330B Synthesizer	NLLLL.LL;(CR)(LF)	Lfffff.fff>(CR)(LF)
2	Format suitable for HP 3335A Synthesizer	ALLLL.LLK(CR)(LF)	FFffffff.fffKH(CR)(LF)
3	Format suitable for HP 3336A Synthesizer	AMLLLL.LLDB	FFffffff.fffKH(CR)(LF)
4 to 9	Same as position 1	NLLLL.LL;(CR)(LF)	Lfffff.fff>(CR)(LF)

Where: fffff.fff = Synthesizer tuning frequency in KHz
LLLL.LL = Synthesizer amplitude in dBm
(CR) = Carriage return
(LF) = Line feed

Figure 5-14 Internal Switch 2 Settings

5-68 Internal Switch 3

5-69 An area of the SLMS's internal memory may be loaded (via data sent over the HP-IB) with a special FDM plan. As shown in Table 5-6, internal switch 3 enables the SLMS to select between this special FDM plan and the FDM plans defined by the front panel FDM PLAN switches.

Table 5-6 Internal Switch 3 Settings

Switch Setting	FDM Plan Selected
1	As defined by the front panel FDM PLAN switches
2	Special FDM Plan
3 to 9	Same as switch position 1

5-70 Internal Switch 4

5-71 Internal Switch 4 affects the operation of the Limits Comparison Store used by the SLMS when making Limit Comparison sweeps (to select a Limit Comparison Sweep set the PRINT switch to the COMP position, see Section 3 for further details). In position 1 the Limit Comparison Store is cleared before the first sweep and all measurements that cause a limit alarm will be printed out on the first sweep. In positions 2 through 9 The existing contents of the Limit Comparison Store are retained for the first sweep and only measurements whose limit alarm status is different from that indicated by the Limit Comparison Store will be printed out on the first sweep.

Table 5-7 Internal Switch 4 Operation

Switch Setting	Limit Comparison Store Operation
1	Store contents cleared before first sweep
2 to 9	Exising store content used on first sweep

5-72 SLMS SERVICE REQUEST OPERATION

5-73 To determine the cause of a service request, the system controller should conduct a serial poll. In a serial poll the system controller may use any of the SLMS talk addresses to allow the SLMS to return its serial poll response. The SLMS response to the serial poll indicates the SLMS status and whether or not the SLMS is generatng the service request. Table 5-8 illustrates the SLMS's responses to a serial poll.

5-74 Polling an SLMS to determine its status will clear any service request it may be generating. Note however, that where the SLMS has requested service because it requires one of its talk addresses, polling the SLMS will clear the SRQ generation but the SLMS status reply to a subsequent serial poll will still indicate that a talk address is required.

Note: Once the SLMS generates an SRQ, the SRQ can only be cleared by conducting a serial poll. If the reason for the SLMS raising SRQ is satisfied without conducting a serial poll the SLMS will continue generating the SRQ until a serial poll is conducted. The response to this serial poll will not show the original reason that the SLMS requested service but will show the current state of the SLMS (busy, idle etc).

Table 5-8 SLMS Service Request Serial Poll Responses

Response Meaning	Serial Poll Response		SLMS Causing Service Request
	Octal	Decimal	
SLMS Talk address No 1 still required	002	2	NO
SLMS Talk Address No 2 still required	003	3	NO
SLMS Idle (Halted)	006	6	NO
SLMS Busy (Measuring)	007	7	NO
SLMS Talk Address No 3 still required	010	8	NO
SLMS Idle (Halted)	046	38	NO
End of Single Measurement	101	65	YES
SLMS requires its Talk Address No 1	102	66	YES
SLMS requires its Talk Address No 2	103	67	YES
SLMS showing Error Code in its display	104	68	YES
Front panel LOCAL key pressed	106	70	YES
SLMS Requires its Talk Address No 3	110	72	YES
Front Panel LOCAL key pressed when SLMS in Local Lock-out mode. (Key ignored)	126	86	YES
Unrecognised data received by SLMS.	146	102	YES

5-75 SLMS RESPONSE TO THE DEVICE TRIGGER MESSAGE

5-76 When addressed as a listener, the SLMS responds to the HP-IB command Group Execute Trigger as if it had been sent the measure keycode.

5-77 SLMS RESPONSE TO SELECTIVE DEVICE CLEAR

5-78 The SLMS will always respond to the HP-IB command Selective Device Clear by immediately executing the following actions

1 The current measurement is aborted, pending HP-IB messages are abandoned and the SLMS halts.

2 Front panel operation is inhibited and the SLMS enters the remote listen state.

3 Any service request is cleared.

4 All front panel switches are programmed to their leftmost position and AUTO FILTER is selected.

5 Display averaging is set to Averaging 1, auto-untalk is disabled and messages to the CRT Display are disabled.

6 The internal program switches are set as follows

Internal switches 1 and 2 go to position 3
Internal switches 3 and 4 go to position 1

5-79 The Selective Device Clear command does not affect the following

1 Any Access Switch setting is preserved.

2 The SLMS internal memory is not cleared.

5-80 SLMS RESPONSE TO DEVICE CLEAR

5-81 The SLMS will always respond to the HP-IB command Device Clear by executing the following.

1. The current measurement is aborted, and the content of the frequency register is displayed and the SLMS halts.

2. No change is made to the SLMS registers unless the SLMS detects corruption of its memory. If corruption is detected all registers are cleared and the frequency register is reset to 1MHz.

   Note: The month, day and time generated by the SLMS internal clock are not part of the working memory and will not be cleared. However, the years register is held in memory and will be cleared if memory is reset.

3. Auto untalk is disabled, display averaging is set to 1

4. All front panel switches are programmed to the same position as their front panel setting

5. The internal program switches are set as follows

   Internal switches 1 and 2 go to position 3
   Internal switches 3 and 4 go to position 1

5-82 The Device Clear command does not affect the SLMS's HP-IB status and the SLMS will retain the same status (talker,listener or local) that it had before the Device Clear command.

5-83 SLMS REMOTE/LOCAL OPERATION

5-84 Before being addressed as either a talker or listener, the SLMS is under front panel (local) control. In order to program the SLMS it must be addressed. Once addressed the SLMS enters the remote mode and will remain in this mode even though the SLMS subsequently is unaddressed. In the remote mode the SLMS front panel is disabled except for the LOCAL key. Pressing the LOCAL key returns the SLMS to local control. The LOCAL key may be disabled by sending the HP-IB command Local-Lockout.

5-85 The HP-IB command Go-To-Local may be sent at any time to return the SLMS to local control.

5-86 SLMS RESPONSE TO GO-TO-LOCAL

5-87 The SLMS will respond to the HP-IB Go-To-Local command when it is a listener. In the local mode the front panel keyboard is enabled and all switches assume their physical position.

5-88 SLMS RESPONSE TO THE PARALLEL-POLL MESSAGE

5-89 The SLMS does not respond to the HP-IB Parallel-Poll command.

5-90 PROGRAMMING NOTES

5-91 The sequence in which functions are set up should be the same as that used when the SLMS is operated manually via the front panel.

5-92 The SLMS can only be programmed when it is halted. If the SLMS is making a measurement and a key or switch programming code is sent, the SLMS will halt.

5-93 The SLMS must be addressed to talk with the appropriate talk address before it can output messages onto the HP-IB. The SLMS has three separate talk addresses, each talk address being used for a different message type.

Talk address No 1 - Used to output measurement data and error codes. This Talk address is used for all messages which originate from the setting of either the front panel PRINT switch, internal switch 1 (Printer Message Format) or transmission of the PRINT code.

Talk Address No 2 - Used to output messages to a Frequency Synthesizer. This talk address is used for all messages which originate from the setting of the GEN TRACK switch to either of the BUS positions.

Talk Address No 3 - Used to output messages to a HP 37461A CRT Display. This talk address is used for all messages which originate from the sending of the CRT enable code.

5-94 Any of the three talk addresses may be used during a serial poll to enable the SLMS to transmit its status byte.

5-95 Each time the SLMS requires a talk address to output a message onto the HP-IB it will request service (set SRQ). The SLMS's response to a serial poll will indicate which of its talk addresses it requires.

5-96 There are two HP Publications available which give information on using the SLMS with the HP 85A Personal Computer and the HP 9825 Desktop Computer; they are as follows:

(1) Programming Note - Operating Guide for the 3746A SLMS with the HP 85A Personal Computer (Part Number 5953-6687).

(2) Programming Note - Operating Guide for the 3746A SLMS with the HP 9825 Desktop Computer (Part Number 5953-6688).

SECTION VI

SECTION VI
CONTROLS, CONNECTORS AND INDICATORS

6-1 INTRODUCTION

6-2 This section gives a complete description of the function of each control, and the significance of each indicator. Figure 3-1 identifies all front panel controls, connectors and indicators. Figure 3-2 identifies all rear panel controls, and connectors. The number opposite each control, connector and indicator in Figure 3-1 and 3-2 correspond to the numbers opposite the description in this section.

Note: Unless otherwise stated pressing any of the control keys will put the 3746A in the HALT mode (LED on HALT key lit) until new data is entered or a new measurement sequence is initiated and the MEAS key is pressed to start a new measurement.

6-3 CONTROLS (FRONT PANEL)

1. **POWER:** Switches power to the 3746A from STANDBY (STBY) to ON or ON to STBY. In the STBY position power is still supplied to the oven used in the Master Oscillator (to maintain it at operating temperature) and to the non volatile memory. The +/-15.5V rear panel dc POWER SUPPLY OUTPUT is also ON in the STBY position.

2. **PLAN SELECTION:** These three switches select the relevant BELL or CCITT FDM plan. Section VII contains information which will enable the switch positions to be determined for any required plan. Plans relating to the BELL system are marked in blue.

   BELL PLAN SELECTION

   U600-L600: Set according to the formation of the first master-group.

   MMX1-MMX2: Set according to the formation of the multiplex.

   MASTER GPS: This switch is used to set an upper limit on an FDM scan or an FDM entry, and should be set according to the system under test. The four switch positions provide for 1.5 mastergroups (up to 960 channels), 2 mastergroups (up to 1260 channels) and 6 mastergroups up to 3660 channels). The setting of this switch does not affect the tuning range of the FREQ key or Spectrum sweeps.

   CCITT PLAN SELECTION

   1A, 2, 1B: Set according to the formation of the multiplex.

SYSTEM BW: This switch is used to set an upper limit on the bandwidth of an FDM Scan or an FDM entry and should be set to correspond to the bandwidth of the system under test. The four switch positions provide for approximate bandwidths of 4MHz (up to 960 channels), 6MHz (up to 1260 channels), 8MHz (up to 1860 channels), and 12MHz (up to 2760 channels). The setting of this switch does not affect the tuning range of the FREQ key or Spectrum sweeps.

3. PILOT: The two group pilot (GRP) positions specify the frequency of the basic group pilot, either 84.08kHz (84) or 1040.8kHz (104). In either of these standard group pilot settings the following frequencies are specified for the other reference pilots.

BELL		CCITT	
Basic Supergroup	315.92kHz	Basic Supergroup	411.92kHz
Basic Mastergroup	2840kHz	Basic Mastergroup/ Hypergroup	1552kHz
		Basic Supermaster-group	11096kHz

The VC position of the Pilot switch enables the 3746A to perform a level measurement at the Virtual Carrier frequency of any part of the selected plan. The 3746A will tune to the Virtual Carrier of the lowest FDM level specified in the FDM display.

The Non-Standard (NS) position of the Pilot switch selects the content of Non-Standard Pilot (NS PILOT) Register; see description of [NS PILOT] key.

4. [SMG], [HG/MG], [SG], [G], [CH], (FDM Description Keys): These keys are used in conjunction with the Numeric keys to enter FDM descriptions which tune the 3746A to a specific channel, group, pilot etc within the multiplex under test.

CH, G, SG, MG, HG and SMG are abbreviation of channel, group, supergroup, mastergroup, hypergroup and supermastergroup respectively.

For CCITT the [HG/MG] key defines either a 15 supergroup assembly, often called a Hypergroup, found in plans 2 and 1B, or defines a 5 supergroup assembly, commonly known as a Mastergroup, found in plans 1A and 1B. The [SMG] key defines a 3 mastergroup (15 supergroup) assembly, commonly known as a supermastergroup and found in plans 1A and 1B.

Note: The [SMG] key does not apply to Bell plans or to CCITT plan 2.

A full FDM description will tune the SLMS to the specified channel within the multiplex under test. If no channel number is specified then the 3746A will tune to the pilot of the lowest segment specified.

If the FREQ/FDM display is in the frequency mode, then pressing any of the FDM description keys will change the display to the FDM mode. The required FDM description may then be entered by pressing each FDM description key in turn (a '-' will appear on the display) and using the numeric keys to enter the description. The order in which each level in the FDM display is specified is not significant.

5. [1], [2], [3], [4], [5], [6], [7], [8], [9], [10] (Numeric Keys): These keys are used to specify the numbers to be entered into the various registers within the 3746A. Pressing these keys while the 3746A is in the Measurement mode will have no effect.

6. [.] (Decimal Point): Normally used together with the numeric keys to specify the numbers to be entered into the various registers within the 3746A. The decimal point key can also be used to Fix the FDM level at any point in the Multiplex. If during the entry of an FDM description the decimal point is pressed after the entry of an FDM segment, then the decimal points in the FDM Display at this level and above are illuminated. The decimal points signify that these FDM levels will be fixed during a Scan sweep, confining the sweep to that part of the multiplex below these Fixed levels. The fixing may be removed by re-entering the lowest fixed level.

7. [CLEAR/SET]: Has the following uses:-

(1) Clears all displays and clears Access Switches. Does not clear the contents of any of the registers.

(2) Used in conjunction with the numeric keys to specify the Access Test Point number when the 3746A is being used with Access Switches.

(3) Used in conjunction with the Transfer [TR] key to perform certain transfer sequences - see description of [TR] key.

8. [TR]: Pressing the Transfer Key initialises a variety of measurement functions depending on the key sequences that follow. A list and brief description of each Transfer Sequence is given below. More detailed information on the use of the Transfer Key is given in Section III.

TRANSFER SEQUENCES

[TR] [+] [dB/dBm]	Turns equalizer on: when a measurement is performed, correction is applied according to the results of the equalization cycle.
[TR] [-] [dB/dBm]	Turns equalizer off.
[TR] [dB/dBm]	Sets a compatible Tracking Generator (3330B, 3335A, 3336A/B) to the level in the Reference Level Register.
[TR] [dB/dBm] [MEAS]	Performs the equalization cycle: A spectrum measurement is performed at 1MHz intervals between 500kHz and 31.5MHz and the results stored for use by the equalizer routine.
[TR] [SPECT] [MEAS]	Continues spectrum measurement from current frequency in the same direction as previous spectrum.
[TR] [SPECT] [+] [MEAS]	Continues spectrum measurement upwards from current frequency.
[TR] [SPECT] [-] [MEAS]	Continues spectrum measurement downwards from current frequency.
[TR] [SCAN] [MEAS]	Scans from FDM limit, in the same direction as previous scan.
[TR] [SCAN] [+] [MEAS]	Scans upwards from FDM Start point.
[TR] [SCAN] [-] [MEAS]	Scans downwards from FDM Stop point.
[TR] [REF]	Transfers current level reading to the Reference Level register.
[TR] [STEP] [number]	Enters frequency by which entire FDM plan is shifted. Number may be preceded by [-] if negative offset required.
[TR] (FDM description)	Modifies a stored FDM plan by the addition of recognised segments (see Sections III and VII).

[TR] [FREQ/FDM]	Resets the FDM plan to that indicated by plan switches. Start and stop points also reset (but not information held in the FDM skips register). If the 3746A was in the frequency mode then this sequence should be followed by pressing one of the FDM description keys to bring forward the FDM registers.

For certain measurements it is important to be able to select correct demodulation of the sidebands, ie., upper (erect) or lower (inverted) - see Section III. The following two transfer functions permit selection of upper or lower sideband demodulation:

[TR] [LOWER]	Set to lower sideband.
[TR] [UPPER]	Set to upper sideband.
[TR] [LOCAL]	If 3746A is controller (rear panel CNTRLR switch ON) then display shows which peripherals instrument is configured for. If not controller, (rear panel CNTRLR switch OFF) then display shows current HP-IB listen address in decimal and octal.
[TR] [COUNTER] [MEAS]	Measures input frequency and retunes to that frequency.
[TR] [1] [0]	Displays first FDM skip description. (30 available)

followed by:

[+]	Steps up to next FDM skip and increments Register Pointer.
[-]	Steps down to next FDM skip and decrements Register Pointer.
[SMG] [number]	Enters supermastergroup for current skip.
[HG/MG] [number]	Enters mastergroup for current skip.
[SG] [number]	Enters supergroup for current skip.
[CLEAR/SET]	Deletes current skip and enters terminator if less than 30 skips have been entered.

[TR] [1] [1]	Displays first stored frequency (145 available) and sets Register Pointer to 001 in Test Point Display.
followed by:	
[+]	Steps up to next stored frequency and increments Register Pointer.
[-]	Steps down to next stored frequency and decrements Register Pointer.
[number]	Enters frequency at current Register Pointer position.
[.]	Enters decimal point.
[CLEAR/SET]	Enters terminator at current position, indicated by 'End' in the display.
[TR] [1] [9]	Displays time (hours, minutes, seconds)
followed by:	
[FREQ/FDM]	Displays date (day, month, year).
[STOP]	Stops the clock.
[START]	Starts the clock.
[SMG] [number]	Enters hour/day (also stops the clock).
[SG] [number]	Enters minute/month (also stops the clock).
[CH] [number]	Clear seconds/enter year.
[TR] [2] [9]	Measures, displays and prints frequency and level of calibration signal.
[TR] [6] [0]	IF 3746A is controller, turns HP-IB messages to 37461A Display off (overides rear panel CRT switch setting). If 3746A is not controller, overides CR1 and CR0 messages.
[TR] [6] [1]	Enables HP-IB messages to 37461A Display but does not overide rear panel CRT switch setting or CR1/CR0 messages. The 3746A Powers on in this condition.

[TR] [7] [0]	Displays which options are fitted and configuration of chart recorder (current (I) or voltage (U)).
[TR] [CLEAR/SET]	Forces a total reset. All memory including non-volatile memory cleared (year on clock also cleared).

CAUTION

Do not press (TR) (CLEAR/SET) if the 3746A has Random Frequencies, FDM Skip etc stored in the Non-Volatile Memory which are to be retained.

Note: Because key sequence TR CLR/SET clears all the internal registers, the settings of the rear panel switch bank are lost, making the HP-IB Address 00, and losing all control capabilities. These functions and correct HP-IB addresses can be restored by setting the POWER switch to STBY and then to ON. The year setting of the internal clock also needs re-setting, see paragraph 3-135.

9. [+] [-]: These keys have the following functions:

   (1) To indicate the sign of the value entered into the Reference Level Register.

   (2) In the Frequency mode pressing either [+] or [-] will change the frequency to which the 3746A is tuned by an amount equal to the content of the Step Size Register and in the direction indicated. If either key is held depressed then the SLMS will step continuously in the direction indicated.

   (3) If the 3746A is halted during either a Spectrum or Scan sweep, then pressing either [+] or [-] will tune the 3746A by an amount equal to the content of the Step Size Register for Spectrum sweeps and in steps of the lowest specified FDM entry for Scan sweeps.

   Note: The use of [+] or [-] to step a Scan or Spectrum sweep manually is only possible when the GEN TRACK switch is in the OFF position.

   (4) Used in some of the Transfer Functions - See Transfer [TR] key.

10. [MEAS], [HALT]: Either starts a measurement or halts a measurement. The majority of keys interact with the [MEAS] key and will cause the current measurement to Halt. Pressing any of the following keys will NOT halt the current measurement:

All numeric keys, [FREQ/FDM], [dB/dBm], [AVE]

11. [SCAN]: Initiates a series of measurements on either channels, pilots, group powers, supergroup powers, carrier leaks or inter-supergroup noise slots. The scan starts at the FDM segment specified by the FDM display and proceeds by stepping the lowest FDM entry specified. The Scan Sweep will not proceed until the [MEAS] key is pressed.

    The [SCAN] key is also used in some of the Transfer Functions - see Transfer [TR] key.

12. [SPECT]: Initiates a series of level measurements which begin at the frequency held in the [START] Frequency Register and stops at the frequency held in the [STOP] Frequency Register. The frequency is incremented after each measurement by an amount equal to the number held in the [STEP] Size Register. The Spectrum Sweep will not proceed until the [MEAS] key is pressed.

    The [SPECT] key is also used in some of the Transfer Functions - see Transfer [TR] key and in High and Low Level search measurements, see paragraph 3-173.

13. [SG/GP POWER]: (Option 011 Only) Pressing this key when a group is specified in the FDM display will tune the 3746A to the mid-frequency of the specified group. When the [MEAS] key is pressed the group power level will be continuously monitored. Similarly if the lowest FDM segment specified is a supergroup then pressing the [SG/GP POWER] key followed by [MEAS] will continuously monitor the supergroup power level.

    Note: There is no supergroup filter - supergroup powers are calculated by taking the log average of 5 group power measurements.

    Group and Supergroup powers can also be scanned - see [SCAN] key.

14. [INPUT POWER]: Pressing this key followed by [MEAS] will continuously monitor and display the Total Input Power. During this measurement the Frequency/FDM Display will be blanked.

15. [NS PILOT]: Pressing this key displays the contents of the Non-Standard Pilot Register and allows new data to be entered. The [NS PILOT] key is used in conjunction with the PILOT switch which should be set to the NS position.
    The content of the Non-Standard Pilot Register is applied as an offset from the frequency of the virtual carrier of the lowest specified segment in the FDM Display. For example, if the FDM display is specifying a group, then the content of the Non-Standard Pilot Register is treated as the frequency of the basic group pilot. The 3746A will tune to the frequency that this pilot will occupy in the group specified.

The Non-Standard Pilot Register can also be used to perform other FDM measurements such as Intersupergroup Slot Measurements and Channel Signalling Tones - See Section III.

Note: Remember to set the PILOT switch to a position other than NS when the Non-Standard Pilot Register is no longer required.

16. [STEP]: This key displays the content of the Step Size Register and permits new data to be entered.

The Step Size Register contains the frequency increment used to step the frequency to which the 3746A is tuned during Spectrum sweeps and manual tuning using the [+] and [-] keys.

The [STEP] key is also used in some of the Transfer Functions - see Transfer [TR] key.

17. [FREQ]: This key permits the content of the Frequency Register to be displayed and allows new data to be entered.

18. [START] [STOP]: Pressing either of these keys followed by the [FREQ] key will display the content of the appropriate Register - Start Frequency or Stop Frequency - and allows new data to be entered. (See description of [SPECT] key.)

The Start and Stop registers may be loaded with FDM descriptions in order to restrict a scan to part of an FDM plan (see Section III and description of [TR] key).

These keys are also used in some of the Transfer Functions - see Transfer [TR] key.

The Start and Stop Registers hold the frequency limits of Spectrum sweeps and may be loaded as detailed below:

(a) by pressing the [START] or [STOP] key followed by the [FREQ] key and keying in the required values using the numeric keys.

(b) When the FDM display specifies an FDM segment and [SPECT] is pressed then the Start Frequency and Stop Frequency Registers are loaded with the lowest and highest frequencies of the particular FDM segment specified.

(c) When [SCAN] is pressed the Start Frequency and Stop Frequency Registers are loaded with the lowest and highest frequencies that will be encountered during the scan sweep (does not take account of entries made in Start and Stop FDM registers). In certain circumstances, when the Non-Standard Pilot Register is used, the range of a scan may exceed the values held in the Start and Stop Frequency Registers.

The Start Frequency and Stop Frequency Registers also govern the x-axis calibration when the 3746A is used with the Model 37461A Display. The start of the x-axis corresponds to the Frequency held in the Start Frequency Register. Full scale on the x-axis corresponds to the frequency held in the Stop Frequency Register.

19. [REF]: Pressing this key displays the contents of the Reference Level Register and allows new data to be entered. Entries to the Reference Level Register are always in dBm, irrespective of the state of the dB/dBm annunciator and may be either +ve or -ve values. If the 37461A Display is connected to the 3746A then the reference level will be indicated by a short horizontal line on the y-axis.

    This key is also used in the Transfer Functions - see Transfer [TR] key.

20. [UPPER],[LOWER]: Pressing the [UPPER] and [LOWER] key displays the content of the Upper Limit Register and Lower Limit Register respectively and allows new data to be entered.

    Entries to these registers are always in dB's relative to the level held in the Reference Level Register and can be assigned either +ve or -ve values. However, normally the Upper Limit would be +ve indicating dB's above the reference level and the Lower Limit would be -ve indicating dB's below the reference level.

    If the 37461A Display is used then the Upper and Lower Limit Registers will govern the Y-axis calibration. The start of the Y-axis corresponds to the level set by the Lower Limit Register. Full scale on the Y-axis corresponds to the level set by the Upper Limit Register.

    These keys are also used in some of the Transfer Functions - See Transfer [TR] key.

21. [dB/dBm]: This key changes the level displayed to dB's if it was previously indicating in dBm, or to dBm if it was previously indicating in dB's. Measurements made in dB's are referred to the level held in the Reference Level Register. An annunciator to the right of the Level Display indicates whether the Level Display is indicating in dB's or dBm. Pressing this key will not interrupt the measurement sequence.

    This key is used in some of the Transfer Functions - see Transfer [TR] key.

22. FILTER [AUTO], [48kHz], [3.1kHz], [38Hz], [WTD]: These keys select the measurement bandwidth. If the [AUTO] key is selected, the filter is automatically chosen and depends upon the measurement being made. The chosen filter will be indicated by the LED in the middle of the appropriate key being illuminated.

The [AUTO] key will select the 3.1kHz filter when tuning is by means of the [FREQ] key. In Spectrum sweeps it will select, if possible, a filter whose bandwidth is greater than the step size. In FDM measurements the [AUTO] key will select the 38Hz filter for pilot measurements, the 3.1kHz filter for channel measurements.

When Option 015 or 016 is installed the [WTD] key will introduce a weighting network into the demodulated voice channel, prior to the level measuring circuitry.

23. [AVE]: This key used in conjunction with numeric keys [0], [1] and [2] determines the amount of signal averaging and hence speed of measurement and the resolution of the Level Display as follows:

[AVE], [0] - Level Display indicates to 1dB
[AVE], [1] - Level Display indicates to 0.1dB
[AVE], [2] - Level Display indicates to 0.01dB

The time taken for each measurement is not fixed but depends on the filter chosen and the difference in level between successive measurements. Changes in the Averaging [AVE] key will be read when the 3746A is in the measurement mode, however a new calibration cycle will be initiated shown by CAL appearing in the Level Display.

Note: Measurement resolution is restricted to 0.1dB when I/P POWER, 48kHz, WTD or notch filters are selected.

24. GEN TRACK: This switch has four positions, three of which govern interaction of the 3746A with a suitable external signal generator/frequency synthesiser. The fourth position provides a receiver only mode of operation.

OFF - Is normally selected when monitoring an FDM system. In this mode only 3746A interval considerations will determine the measurements and measurement rate used.

BUS STAB - After two consecutive measurements within 1dB of each other [AVE] [0], 0.2dB [AVE] [1], or 0.05dB [AVE] [2] and within the limits entered, the 3746A retunes to the next point in the sweep. If the 3746A is configured as an HP-IB controller, it outputs on the bus, a message to retune the Frequency Synthesiser to the next point in the sweep. If not configured as a controller, an HP-IB SRQ is generated.

BUS LIM - After two consecutive measurements within the limits entered, the 3746A tunes to the next point in the sweep. If the 3746A is configured as an HP-IB controller, it outputs on the bus, a message to retune the Frequency Synthesiser to the next point in the sweep. If not configured as a controller an HP-IB SRQ is generated.

O/LP - Open Loop is selected when the 3746A is required to track the frequency of a stepping Signal Generator. After two consecutive measurements within the limits entered, and 1dB of each other [AVE] [0], 0.2dB [AVE] [1] or 0.05dB [AVE] [2] the 3746A retunes to the next point in the sweep.

25. LIMIT HALT: When switched to ON the 3746A will Halt at the current measurement when a Limit Alarm is given, as determined by the setting of the LIMITS switch. The measurement will not proceed even if the signal level returns within limits and will only proceed when [MEAS] is pressed.

26. MEASUREMENT: This switch has the following two positions.

CONT - Measurement, Spectrum or Scan Sweep is carried out continuously until either the [HALT] key is pressed or one of the other front panel controls which cause a measurement to Halt is pressed.

SINGLE - For Spectrum sweeps, the sweep starts from the frequency held in the Start Frequency Register and reverts to the HALT mode when the frequency held in the Stop Frequency Register is reached. For a Scan sweep, the sweep starts from the FDM level defined in the FDM display and reverts to the HALT mode when it reaches the FDM level held in the Stop Register.

For any other measurements a single measurement will be made before the 3746A reverts to the HALT mode.

27. LIMITS: Determines which, if any, of the out of limits indications cause a Limit Alarm. Changes in the setting of the LIMITS switch will be read when the 3746A is in the measurement mode.

28. PRINTER: This switch controls the operation of a Printer connected to the 3746A as follows:

    LIM - The Printer will print only those measurements which cause a Limit Alarm.

    CONT - The Printer will print the result of every measurement.

    COMP - The Printer will print all Limit Alarm conditions the first time through a Spectrum or Scan sweep. On subsequent sweeps only changes in Alarm condition between successive sweeps will cause a print out. Spectrum sweeps with >1024 points or Channel Scans are not permitted and will result in an error code in the TEST-POINT Display.

29. TERMINATION [75 Ohm], [150 Ohm], [600 Ohm]: These keys select between the 75 Ohm unbalanced input connector, the 150 Ohm balanced input connector or the 600 Ohm balanced input connector. For Option 005 the 150 ohm balanced input is replaced with 124 Ohm and 135 Ohm balanced connectors.

30. [FREQ/FDM]: Used to alternate the FREQ/FDM Display between the current FDM description (FDM annunciator lit) and the current FDM frequency (FDM, FREQ and kHz annuciators lit).

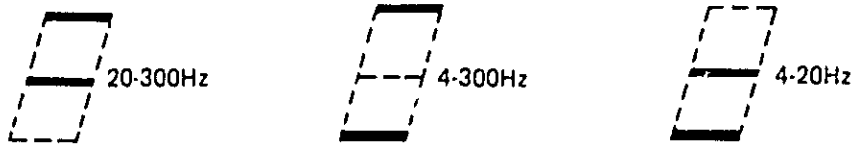
    This key can be pressed while the 3746A is in the Measurement mode without causing it to revert to the Halt mode.

    The [FREQ/FDM] key is also used in some of the Transfer Functions - see Transfer [TR] key.

31. [COUNTER]: Pressing [COUNTER] [MEAS] will measure the frequency of the input signal (subject to the specifications given in Section I). This key is also used in the Transfer Functions - see Transfer key [TR].

32. [IMP NOISE]: Used in conjunction with [TIME], [THRESH] and [MEAS] keys to set up measurement parameters and initiate an Impulse Noise measurement.

33. [TIME /ϕ Jitter]: In Impulse Noise mode, pressing [TIME] allows the measurement period to be entered using the numeric keys. If not in Impulse Noise mode, pressing [0 JITTER] selects the Phase Jitter measurement mode. Three measurement bandwidths are available for phase jitter measurements, 20 to 300Hz, 4 to 300Hz and 4 to 20Hz. Bandwidth is selected by pressing the key to obtain one of the following displays as required:



34. [THRESH NWT]: In Impulse Noise mode, pressing [THRESH] allows the threshold level (in dB relative to the reference level) to be entered using the numeric keys. If not in Impulse Noise mode, pressing [NWT] permits Noise with Tone measurements using a notched filter.

35. [GAIN] : Pressing this key will Halt the current measurement and display the internal GAIN of the 3746A, (in dB) between the 75 ohm input and rear panel Audio Output, derived from the settings of the various amplifiers and attenuators. To continue the measurement sequence only the [MEAS] key need be pressed. The gain can be incremented/decremented in 5dB steps by the [+] or [-] keys.

36. [LOCAL]: Used to return the 3746A from HP-IB control to Local (Front Panel) operation - only if LOCAL LOCKOUT (LLO) is not in operation.

37. AUDIO VOL: Regulates the audio output from the internal loudspeaker and front panel jack.

6-4 INDICATORS

38. FREQ/FDM DISPLAY : When the 3746A is in the Halt mode the Display is used to indicate the content of the various frequency and FDM registers. In the measurement mode the display indicates the frequency or FDM segment to which the 3746A is tuned.

39. TIME: Illuminated when [TR] [1] [9] is entered, to indicate that the FREQ/FDM display is the 3746A Real Time Clock.

40. PILOT: Indicates that the frequency to which the 3746A is tuned is that of a pilot in the FDM multiplex.

41. FDM: Illuminated on its own when the FREQ/FDM display is an FDM description. When the display is in the form of a frequency related to the FDM plan, then the FREQ and kHz annunciators will be lit in addition to the FDM annunciator.

42. FREQ: Illuminated together with the kHz annunciator when FREQ/FDM display is in the Frequency mode. See also description of FDM annunciator.

43. ◿ ◺: The triangular symbols indicate whether the channel to which the 3746A is tuned is erect or inverted.

    ◿ indicates an erect channel in which the audio frequencies from left to right.

    ◺ indicates an inverted channel in which the audio frequencies increase from right to left.

44. kHz: See descriptions of FDM and FREQ annunciators.

45. STBY: Illuminated when the POWER switch is in the STBY position - see POWER SWITCH description.

46. LEVEL DISPLAY: In the Measurement mode indicates the measured level of the input signal at the current frequency or FDM description indicated on the FREQ/FDM Display. In the Halt mode it enables the content of the various Level Registers (REF, UPPER, LOWER) to be displayed.

    Also used with various options to display Phase Jitter, Impulse Noise Thresholds etc - see descriptions of [IMP NOISE] [TIME/0 JITTER] and [THRESH/NWT] keys.

47. EQLZD: Illuminated when [TR] [+] [dB/dBm] key sequence is pressed indicating that equalization coefficients are being applied to the measured levels. The equalization coefficients are stored during the equalization cycle, initiated by pressing [TR] [dB/dBm] [MEAS].

48. OVEN: Indicates that the oven used in the Master Oscillator is not at its operating temperature (Option 013 only).

49. L LIM/U LIM: Indicates that the current measurement is outside the limits held in the UPPER and LOWER Limit Registers.

50. pk-pk: Illuminated when Phase Jitter measurement is initiated - see [0 JITTER] key description.

51. dB/dBm: Indicates the units in which the measured level is displayed. When the dB annunciator is lit the measured level is displayed relative to the level held in the Reference level Register.

52. STATUS: Indicators display status of the instrument when Operating via the HP-IB ie, REMOTE, LISTEN, TALK and SRQ - See Section V.

53. TEST POINT DISPLAY: This display is used for the following functions:

(1) Displays test point selected using numeric keys when the 3746A is used with an Access Switche(s).

(2) Displays Error Codes - See section VII.

(3) Used as a Register Pointer for FDM skips and stored frequency facilities.

6-5 CONNECTORS (FRONT PANEL)

54. 75 Ohm (UNBALANCED): Accepts input signals up to +20dBm, 50Hz to 32MHz.

55. 150Ohm (BALANCED) or 124/135 Option 005: Accepts input signals up to 0dBm.

Frequency Range - 150/135 Ohm, 10kHz to 2MHz
124 ohm, 10kHz to 12MHz.

56. 600 Ohm (BALANCED): Accepts input signals up to 0dBm, 50Hz to 100kHz.

57. PROBE POWER: Supplies power to Hewlett-Packard Model 15578A Active High Impedance Probe.

58. PHONE: Jack Plug connector for headphone monitoroing of demodulated channel.

6-6 CONNECTORS (REAR PANEL)

59. Input power connector. (see Section II Installation).

60. Input power, voltage and fuse selection. (see Section II Installation)

61. HP-IB CONNECTOR: Hewlett-Packard Interface Bus (HP-IB) connector.

62. When operating on HP-IB with an external controller the first five switch positions determine the Instrument Address. When the 3746A is acting as controller these switches configure the 3746A to drive various peripherals via the HP-IB (see Section IV).

63. **TEST POINT SPEED:** Used when 3746A is connected to an Access Switch(es) and set to coincide with the speed selected on the Access Switch(es).

64. **10MHz OVEN:** (Option 013 only) Provides a 10MHz output from the 3746A Master Oscillator. The output level is nominally 0dBm into 50 Ohm. Normally linked to 10MHz REF INPUT.

65. **10MHz REF:** Allows an external 10MHz Reference signal to replace the 10MHz signal from the internal oscillator. The 10MHz Reference input signal level should be within -3 to +20dBm into 50 Ohm. If the instrument is fitted with Option 013 then this input is normally linked to the 10MHz OVEN OUTPUT.

66. **10MHz:** Provides a 10MHz output from the 3746A internal oscillator at an output level selectable internally, of either +6dBm into 50 Ohm or -30dBm into 75 Ohm (see Section II Installation).

67. **TRACKING GENERATOR:** (Option 012 only) Provides an output which tracks the frequency to which the 3746A is tuned. The output level is nominally -10dBm into 75 Ohm.

68. **TEST POINT:** : Provides CONTROL OUTPUT for connection of Access Switch 'Twisted Pair' and POWER SUPPLY OUTPUT for supplying +-15V dc to one Access Switch.

69. **CHART RECORDER:** Provides either current or voltage output drive (internally selectable - see Section II) suitable for connection to an external Chart Recorder or Meter. Output is proportional to measured level of 3746A input signal (after entering within dynamic range). Dynamic range is +/-3dB corresponding to +/-3V DC for voltage dirve and 0 to 5mA for current drive.

70. **AUDIO:** Provides Demodulated Voice Channel Output on Jack Plug connector. Output Level is 0 to -7dBm into 600 Ohm balanced.

71. **AUDIO:** Same as 70 except connector is Siemens 3 Pin.

72. **PHASE JITTER:** Provides access to the sidebands on the demodulated 1kHz tone, 4Hz to 300Hz - as selected by the [0 JITTER) key - to allow external analysis.

73. **BRIDGED - ALL INPUTS:** This key is fitted to all instruments on and above serial numbers 2405U-00412. Pressing the key selects/deselects the BRIDGED inputs. In the Bridged state, all inputs are configured to a high impedance state suitable for making measurements in FDM systems with unprotected monitor points.

A switch A60S2 (8) located on the Controller assembly (A60) can be pre-set to determine the "wake-up" mode of the instrument. If A60S2 (8) is set to the 'ON' position the instrument will have all inputs in the BRIDGED state at power on. If A60S2 (8) is OFF the instrument "wakes-up" with all inputs in the TERMINATED mode.

APPENDIX

SECTION VII

APPENDICES

7-1 INTRODUCTION

7-2 This section of the manual contains information on Error Codes and FDM plans.

7-3 ERROR CODES

7-4 If the operator attempts to make an invalid measurement or if incorrect data is entered via the keyboard, an error will appear in the TEST-POINT Display. In addition, some internal circuit conditions and test programs will cause an error code to be displayed. The significance of each error code is explained below.

0	**STEP, FRACTIONAL N and SUM LOOPS UNLOCKED***	E01 Reference Frequency loop unlocked E02 Step Loop unlocked E03 Fractional N Loop unlocked E04 Sum Loop unlocked E05 Step and Fractional N Loop unlocked E06 Step and Sum Loops unlocked E07 Fractional N and Sum Loops unlocked E09 Step, Fractional N and Sum Loops unlocked

*Refer to Service Manual.

1	**FREQUENCY TOO HIGH**	E11 Frequency entry too high E12 Start Frequency too high E13 Stop Frequency too high E14 Step Frequency too high E15 Non-Standard Pilot Frequency t[illegible] high E16 Attempt to tune to a frequenc[illegible]hich is too high E17 Stop Frequency less than Start [illegible]equency
2		E24 Attempt to measure Random Frequencies when array empty
3	**LEVEL OR THRESHOLD OUT OF RANGE**	E31 Reference Level too high or too low E32 Upper Limit too high or too low E33 Lower Limit too high or too low E35 Attempt to select option not fitted E36 Threshold greater than +20dBm E37 Threshold too low E39 Undefined test function selected

4	**FDM ENTRY TOO LOW**	E41 Channel entry too low E42 Group entry too low E43 Supergroup entry too low E44 Hypergroup/Mastergroup entry too low E45 Supermastergroup entry too low
5	**FDM ENTRY NOT CONSISTENT WITH PLAN**	E51 Channel entry inconsistent with plan E52 Group entry inconsistent with plan E53 Supergroup entry inconsistent with plan E54 Hypergroup/Mastergroup inconsistent with plan E55 Supermastergroup inconsistent with plan
6	**FDM ENTRY TOO HIGH**	E61 Channel entry too high E62 Group entry too high E63 Supergroup entry too high E64 Hypergroup/Mastergroup entry too high E65 Supermastergroup entry too high
7	**FDM EXECUTION ERRORS**	E70 FDM array all zeros E71 Mixed dashes and numbers in FDM entry E72 Dash present in FDM entry during scan E73 Zero in Group position during group power measurement E74 Numbers interspersed with zeros in FDM entry E75 Channel not zero during group power measurement E77 Dash in FDM Qualifier, FDM Start or FDM Stop entries E78 Imbalance in Start and Stop FDM descriptions E79 FDM plan switches changed since initial scan cycle
8	**LIMIT COMPARISON AND HP-IB ERRORS**	E80 Limit Comparison Store overflow (more than 1024 points) E81 Unidentified SRQ during serial poll of HP-IB Extender E82 HP-IB cable not connected or all Switches set to 1 E83 Controller conflict (on power-up REN hold low) E84* HP-IB ROM check-sum incorrect E85 Illegal ASCII string E86* HP-IB board running test 00 E87* HP-IB board running test 1 E88* HP-IB board running test 2 E89* HP-IB board running test 4

*Refer to Service Manual

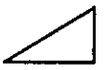
9	A/D, AUTORANGING, OVERLOAD AND CALIBRATION ERRORS	E90* A/D not ready within specified maximum time (level) E91* A/D not ready within specified maximum time (counter) E92 No tone, or tone outside 1010Hz ± 50Hz E94 Overload, signal above +20dBm (75Ω) or 0dBm (other I/Ps) E95* A/D data is not BCD or board not plugged-in E96* Unable to autorange after 20 attempts E97* Calibration signal is out of range E98* Overload detected with no IF gain

*Refer to Service Manual

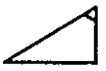
7-5 FDM PLANS

7-6 The 3746A has both CCITT and North American (BELL) FDM plan arrangements stored in memory. The required plan is selected via the front panel PLAN switches.

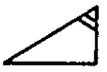
7-7 CCITT plan structures are illustrated in Figures 7-1 to 7-10. BELL plan structures are illustrated in Figure 7-11 to 7-21. The following graphical symbols are used in both sets of plans.



CHANNEL



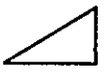
GROUP



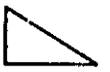
SUPERGROUP

MASTERGROUP/HYPERGROUP

SUPERMASTERGROUP



ERECT FDM SEGMENT (FDM Segment in which the frequency increases with increasing audio frequency)



INVERTED FDM SEGMENT (FDM Segment in which the frequency decreases with increasing audio frequency)

GROUP PILOT

SUPERGROUP PILOT

MASTERGROUP/HYPERGROUP PILOT

SUPERMASTERGROUP PILOT

Note 1: This plan can be modified to include supergroup 1 as illustrated by pressing [TR] [Any FDM key] [SG] [1]. To cancel this modification press [TR] [Any FDM key] [SG] [0].

Supergroup 1 may be further extended to include group A by pressing [G] [8] after entering [TR] [Any FDM kev] [SG] [1]. The structure of supergroup 1 will then be as shown below.

Note 2: All frequencies specified in kHz.

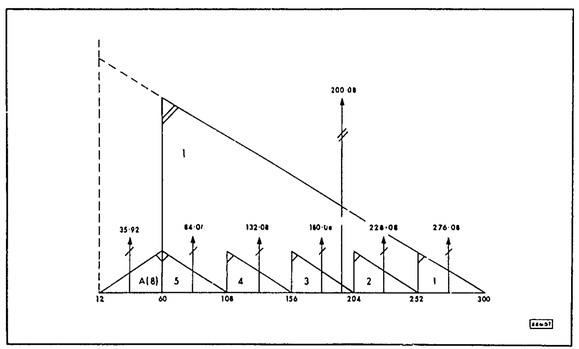


Figure 7-1 Adding Group A (8) to Supergroup 1

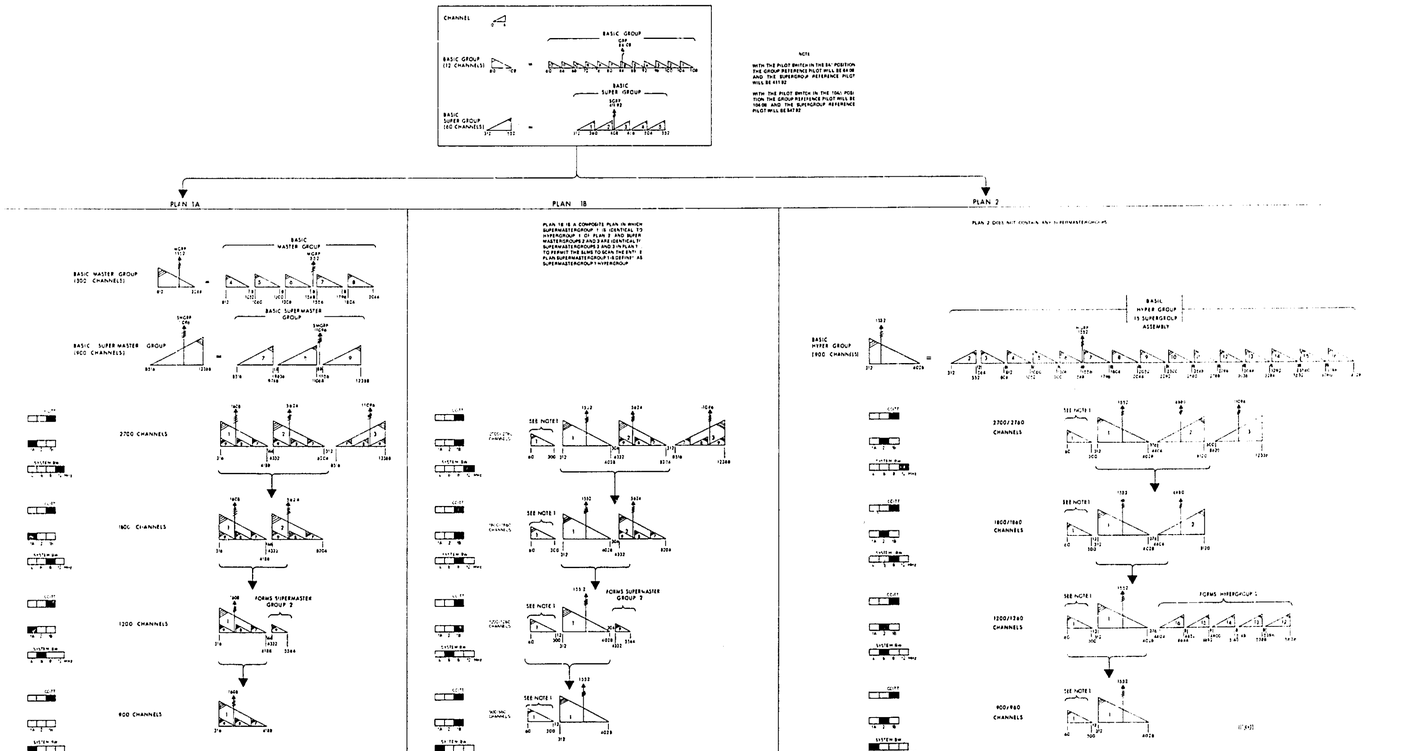
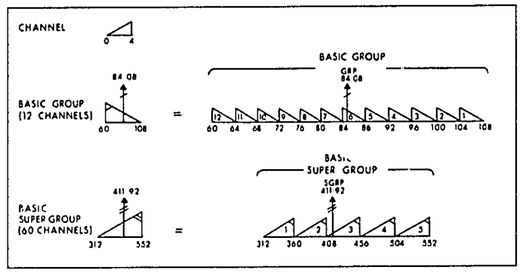


Figure 7-2 CCITT FDM Plan Selection



NOTE

WITH THE PILOT SWITCH IN THE 84.0 POSITION THE GROUP REFERENCE PILOT WILL BE 84.08, AND THE SUPERGROUP REFERENCE PILOT WILL BE 411.92.

WITH THE PILOT SWITCH IN THE 104.8 POSITION THE GROUP REFERENCE PILOT WILL BE 104.08 AND THE SUPERGROUP REFERENCE PILOT WILL BE 547.92.

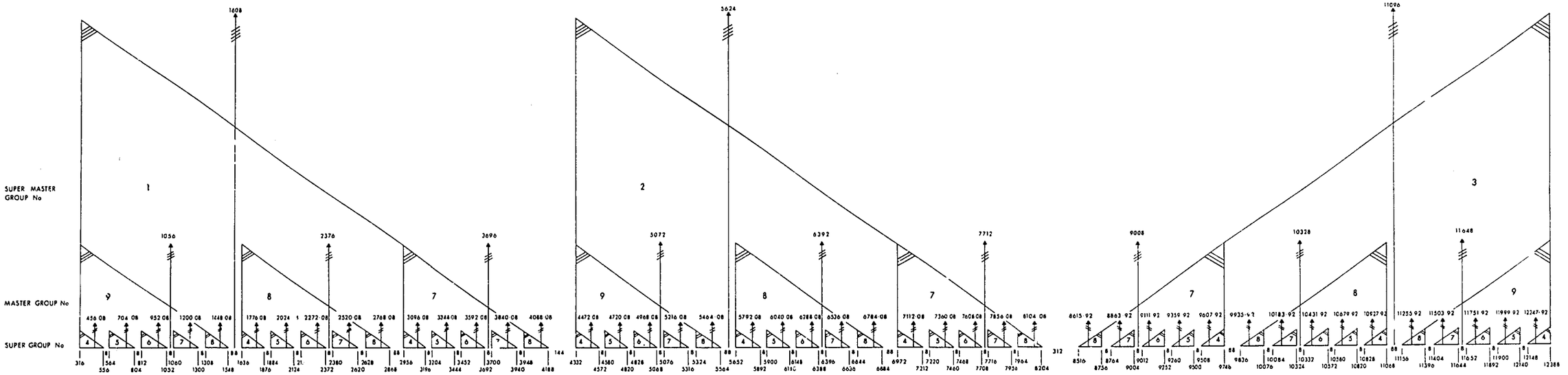


Figure 7-3 CCITT Plan 1A (12MHz,2700 Channels)

APPENDIX

CON'T

Note 1: This plan can be modified to include supergroup 1 as illustrated by pressing [TR] [Any FDM key] [SG] [1]. To cancel this modification press [TR] [Any FDM key] [SG] [0].

Supergroup 1 may be further extended to include group A by pressing [G] [8] after entering [TR] [Any FDM key] [SG] [1]. The structure of supergroup 1 will then be as shown below.

Note 2: All fraquencies specified in kHz.

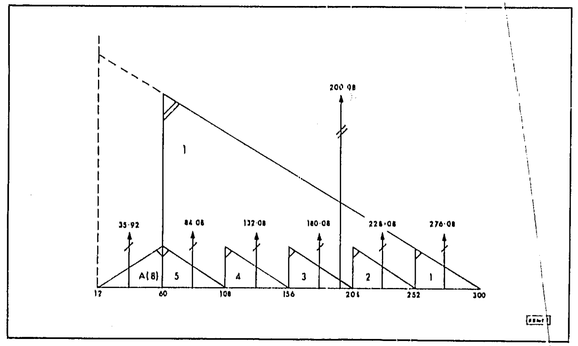
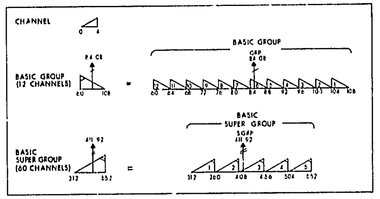


Figure 7-4 Adding Group A (8) to Supergroup 1



NOTE

WITH THE PILOT SWITCH IN THE 643 POSITION THE GROUP REFERENCE PILOT WILL BE 84 08, AND THE SUPERGROUP REFERENCE PILOT WILL BE 411 92.

WITH THE PILOT SWITCH IN THE 1043 POSITION THE GROUP REFERENCE PILOT WILL BE 104 08 AND THE SUPERGROUP REFERENCE PILOT WILL BE 847 92.

PLAN 1B IS A COMPOSITE PLAN IN WHICH SUPERMASTERGROUP 1 IS IDENTICAL TO HYPERGROUP 1 OF PLAN 2, AND SUPERMASTERGROUPS 2 AND 3 ARE IDENTICAL TO SUPERMASTERGROUPS 2 AND 3 IN PLAN 1A. TO PERMIT THE SLMS TO SCAN THE ENTIRE PLAN,HYPERMASTERGROUP 1 IS DEFINED AS SUPERMASTERGROUP 1 HYPERGROUP 1

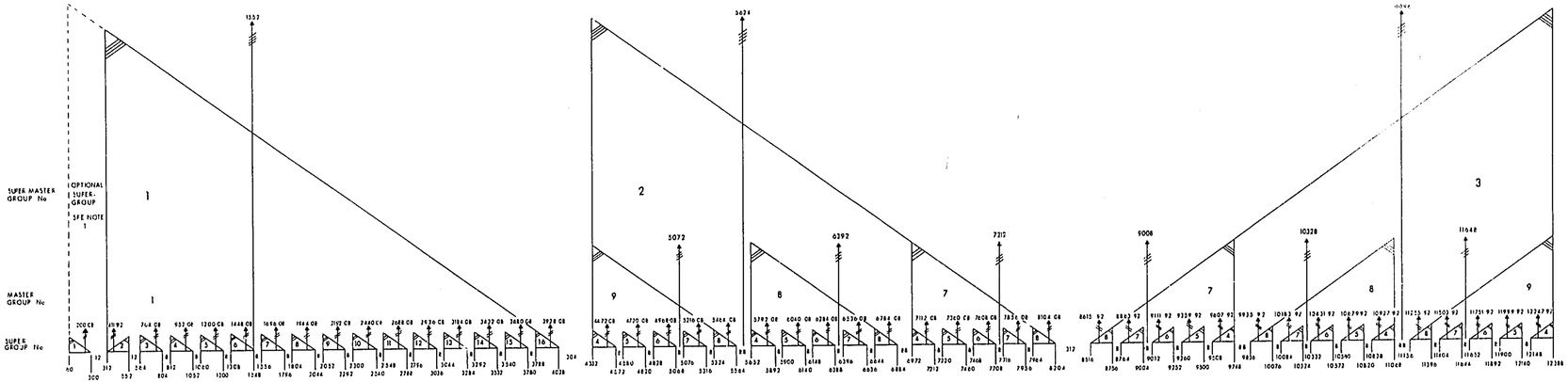


Figure 7-5 CCITT Plan 1B(12MHz,2700/2760 Channels)

Note 1: This plan can be modified to include supergroup 1 as illustrated by pressing [TR] [Any FDM key] [SG] [1]. To cancel this modification press [TR] [Any FDM key] [SG] [0].

Supergroup 1 may be further extended to include group A by pressing [G] [8] after entering [TR] [Any FDM key] [SG] [1]. The structure of supergroup 1 will then be as shown below.

Note 2: All frequencies specified in kHz.

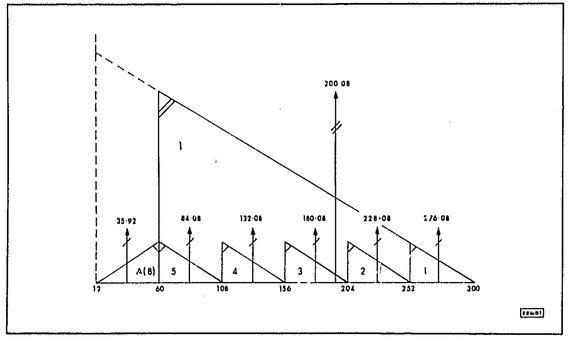
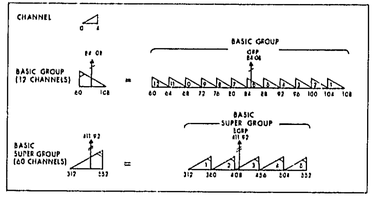


Figure 7-6 Adding Group A (8) to Supergroup 1



NOTE

WITH THE PILOT SWITCH IN THE BAS POSITION THE GROUP REFERENCE PILOT WILL BE 84·08, AND THE SUPERGROUP REFERENCE PILOT WILL BE 411·92.

WITH THE PILOT SWITCH IN THE 1043 POSITION THE GROUP REFERENCE PILOT WILL BE 104·08 AND THE SUPERGROUP REFERENCE PILOT WILL BE 547·92.

PLAN 2 DOES NOT CONTAIN ANY SUPERMASTERGROUPS

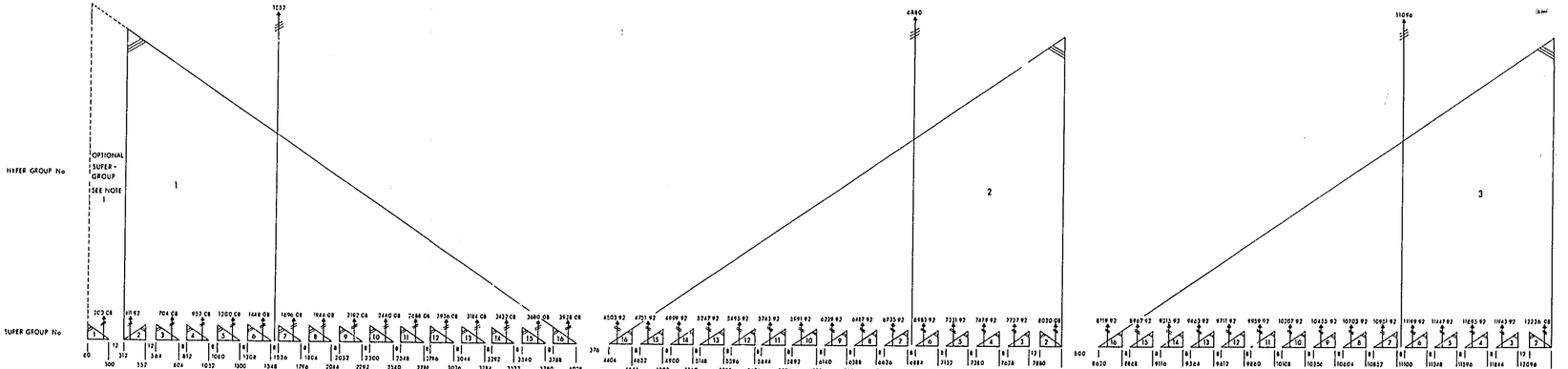


Figure 7-7 CCITT Plan 2 (12MHz, 2700/2760 Channels)

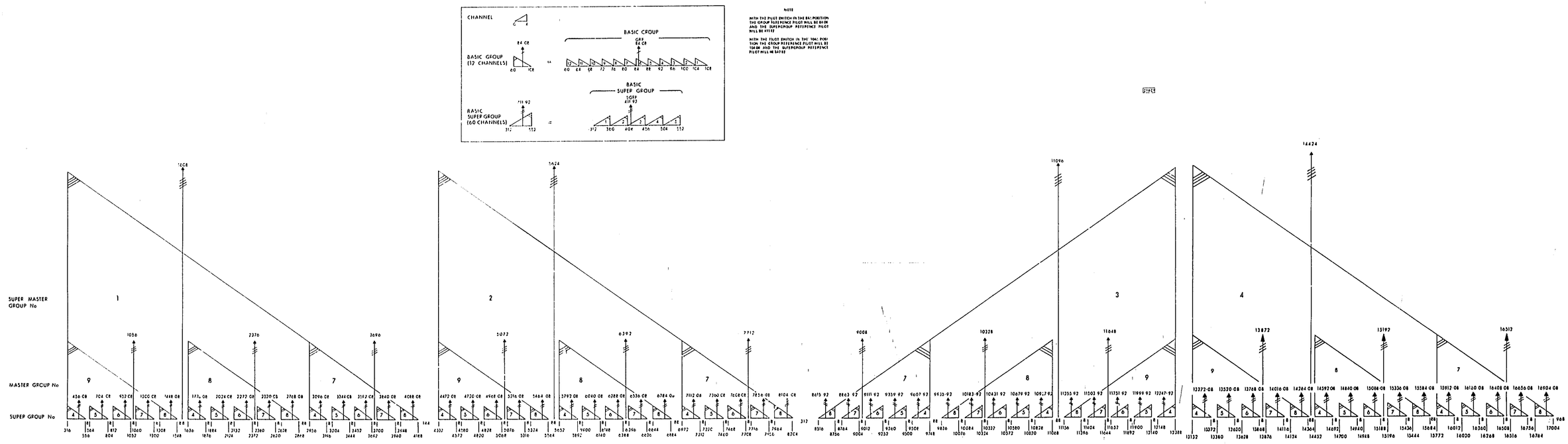


Figure 7-8 CCITT Plan 1A(18MHz, 3600 Channels)

Note 1: This plan can be modified to include supergroup 1 as illustrated by pressing [TR] [Any FDM key] [SG] [1]. To cancel this modification press [TR] [Any FDM key] [SG] [0].

Supergroup 1 may be further extended to include group A by pressing [G] [8] after entering [TR] [Any FDM key] [SG] [1]. The structure of supergroup 1 will then be as shown below.

Note 2: All frequencies specified in kHz.

Note 3: Selection of 18MHz plans is covered in Sections II and III.

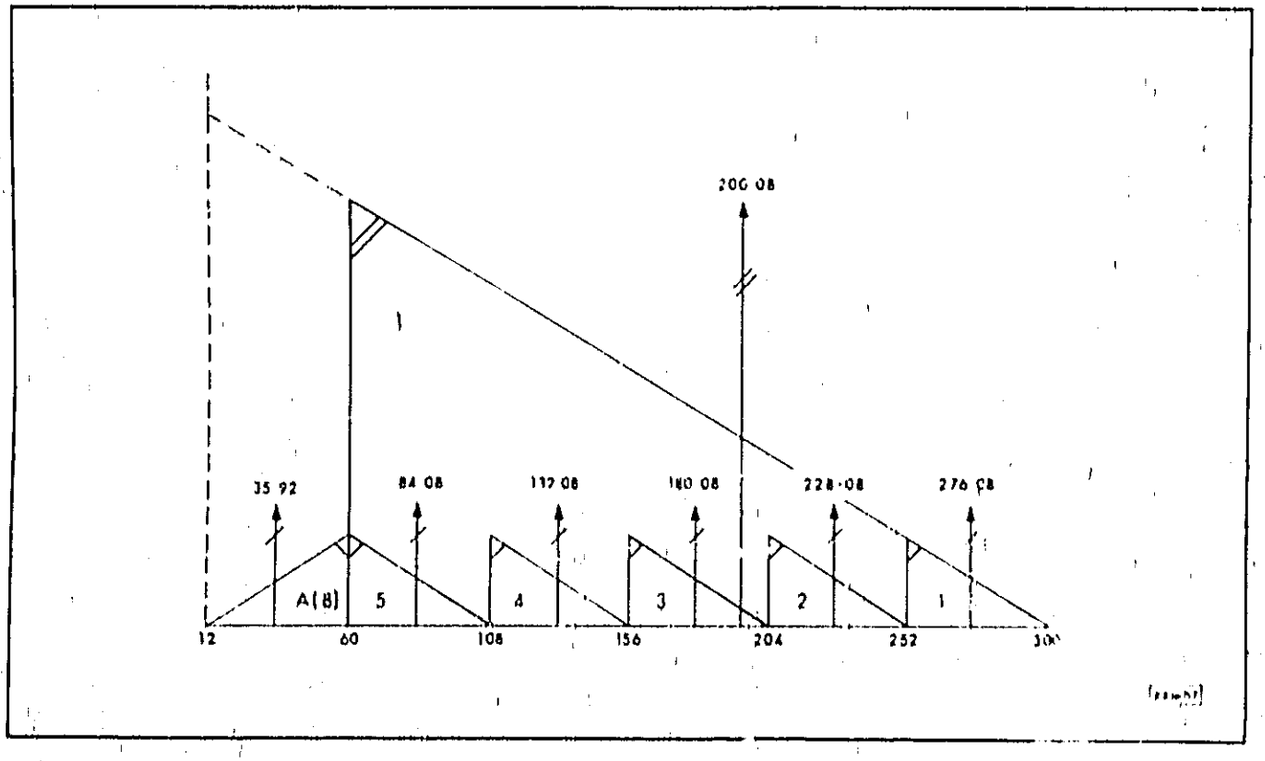
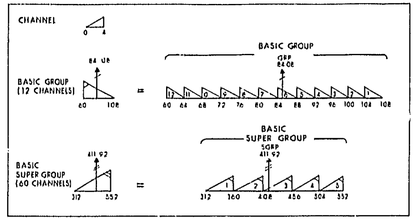


Figure 7-9 Adding Group A(8) to Supergroup 1.



PLAN 2 DOES NOT CONTAIN ANY SUPERMASTERGROUPS

NOTE

WITH THE PILOT SWITCH IN THE 84A POSITION THE GROUP REFERENCE PILOT WILL BE 84.08, AND THE SUPERGROUP REFERENCE PILOT WILL BE 111.92.

WITH THE PILOT SWITCH IN THE 104A POSITION THE GROUP REFERENCE PILOT WILL BE 104.08 AND THE SUPERGROUP REFERENCE PILOT WILL BE 547.92.

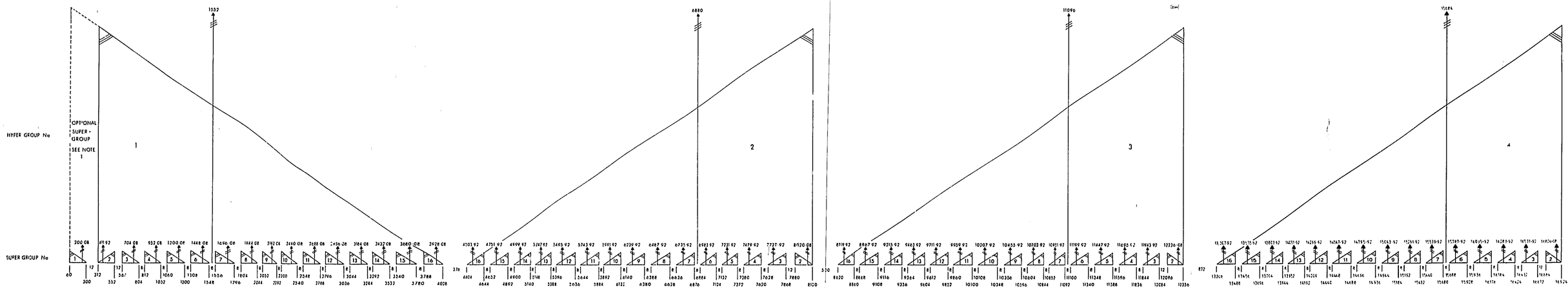


Figure 7-10 CCITT Plan 2 (18MHz,3600/3660 Channels)

NOTE 1

The following modifications can be made to this plan:-

Supergroup 12 can be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [2]. This modification is illustrated in the plan.

Supergroup 11 and 12 may be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [1]. The formation of these supergroups is illustrated in Figure 7-11 below.

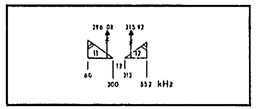


Figure 7-11 Supergroups 11 and 12

The first mastergroup can be replaced by the first ten supergroups in a CCITT hypergroup, by pressing [TR] [Any FDM key] [SG] [1] [0]. The formation of this mastergroup is illustrated in Figure 7-12 below.

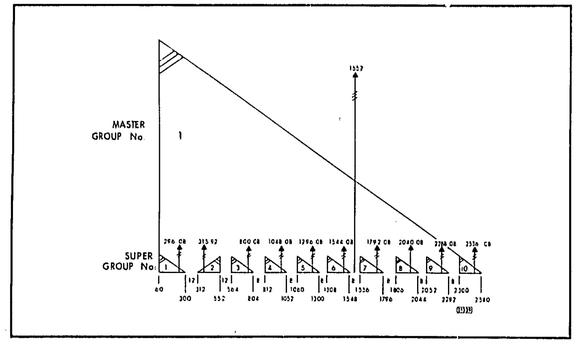


Figure 7-12 CCITT Hypergroup

Only one of these modifications is permitted at any one time. To cancel any of the above modifications press [TR] [Any FDM key] [SG] [0].

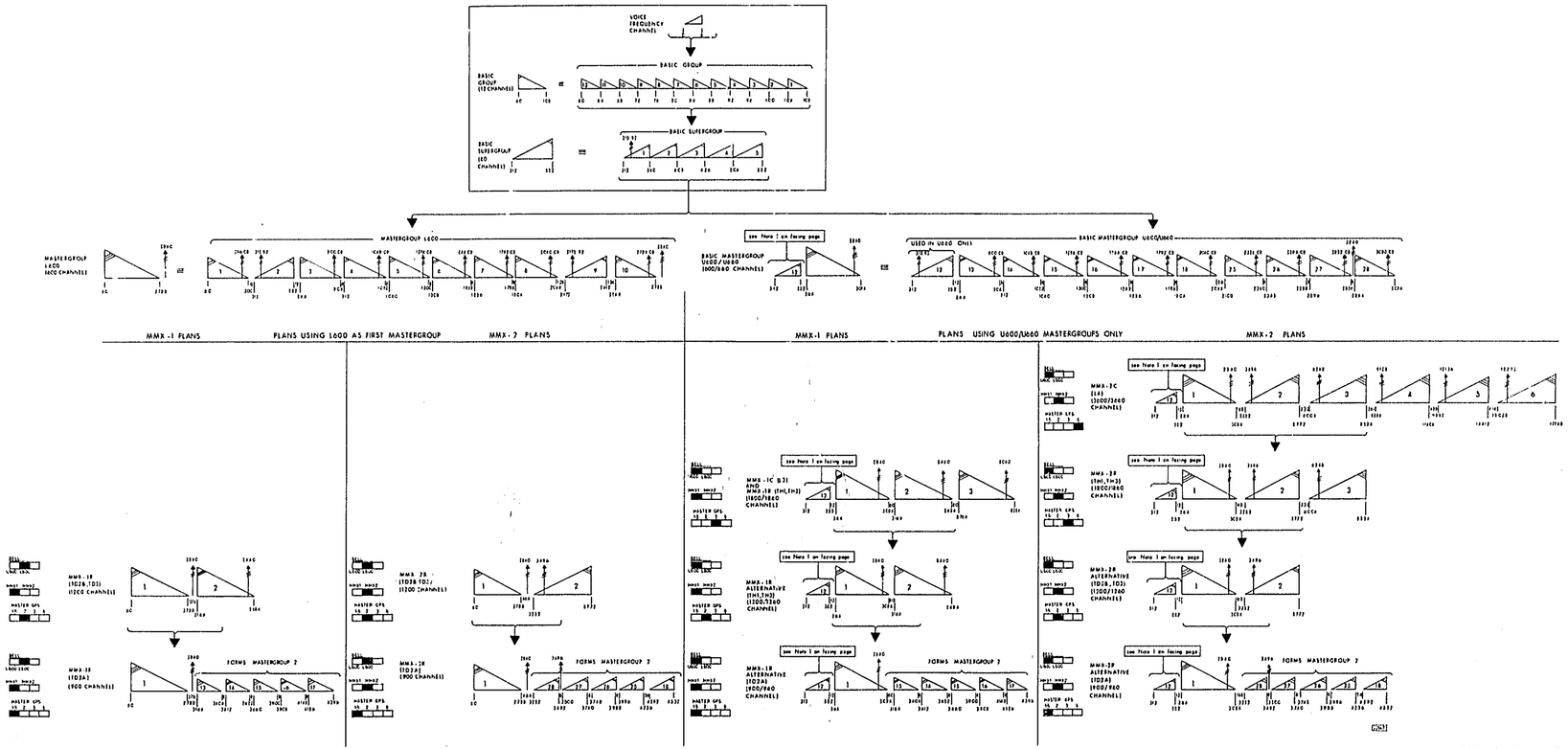


Figure 7-13 Bell FDM Plan Arrangement

NOTE 1

The following modifications can be made to this plan:-

Supergroup 12 can be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [2]. This modification is illustrated in the plan.

Supergroup 11 and 12 may be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [1]. The formation of these supergroups is illustrated in Figure 7-14 below:

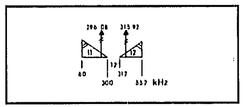


Figure 7-14 Supergroups 11 and 12

The first mastergroup can be replaced by the first ten supergroups in a CCITT hypergroup, by pressing [TR] [Any FDM key] [SG] [1] [0]. The formation of this mastergroup is illustrated in Figure 7-15 below.

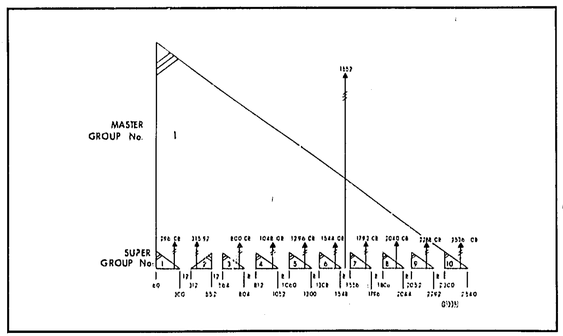


Figure 7-15 CCITT Hypergroup

Only one of these modifications is permitted at any one time. To cancel any of the above modifications press [TR] [Any FDM key] [SG] [0].

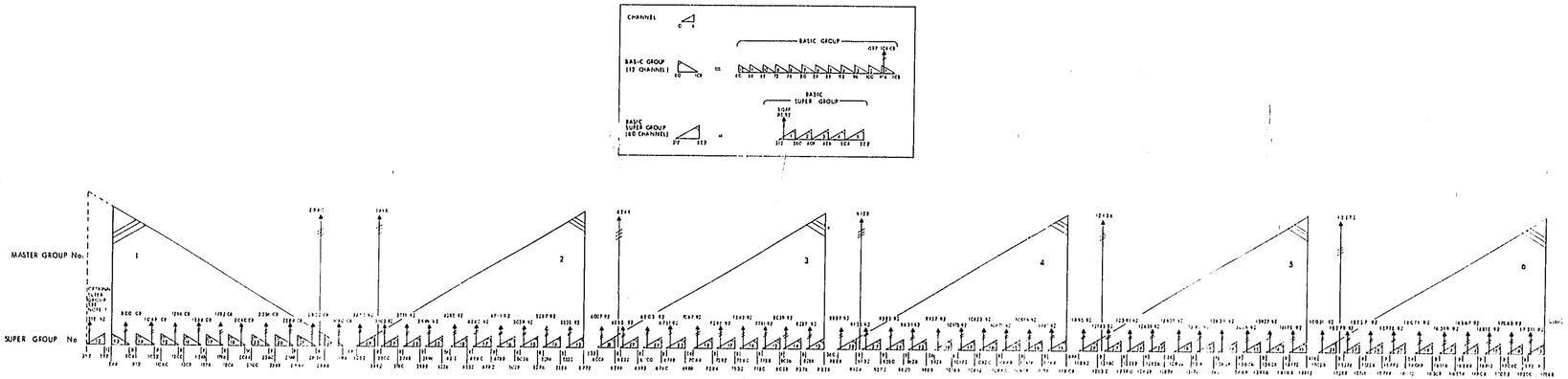


Figure 7-16 MMX–2C (L4) 3600/3660 Chennels

NOTE 1

The following modifications can be made to this plan:-

Supergroup 12 can be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [2]. This modification is illustrated in the plan.

Supergroup 11 and 12 may be introduced into the first mastergroup by pressing [TR] [Any FDM key] [SG] [1] [1]. The formation of these supergroups is illustrated in Figure 7-17 below.

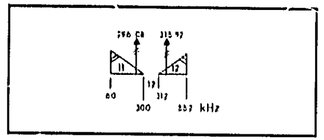


Figure 7-17 Supergroups 11 and 12

The first mastergroup can be replaced by the first ten supergroups in a CCITT hypergroup, by pressing [TR] [Any FDM key] [SG] [1] [0]. The formation of this mastergroup is illustrated in Figure 7-18 below.

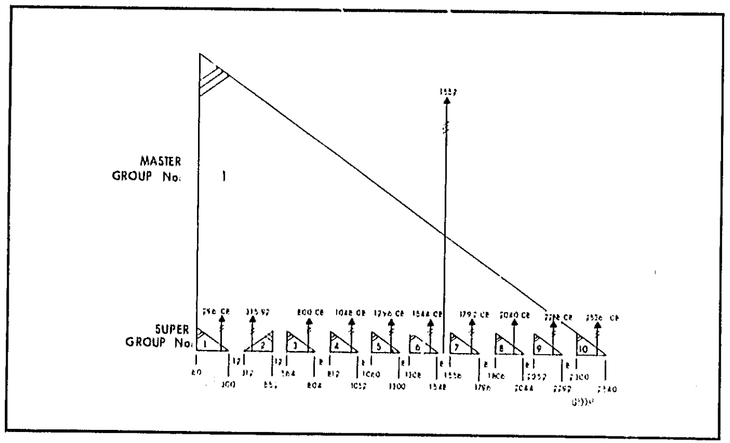
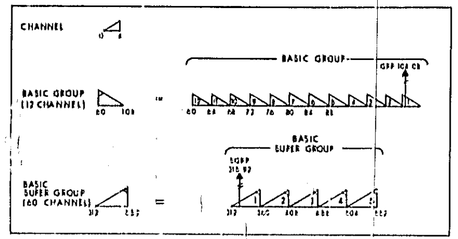


Figure 7-18 CCITT Hypergroup

Only one of these modifications is permitted at any one time. To cancel any of the above modifications press [TR] [Any FDM key] [SG] [0].



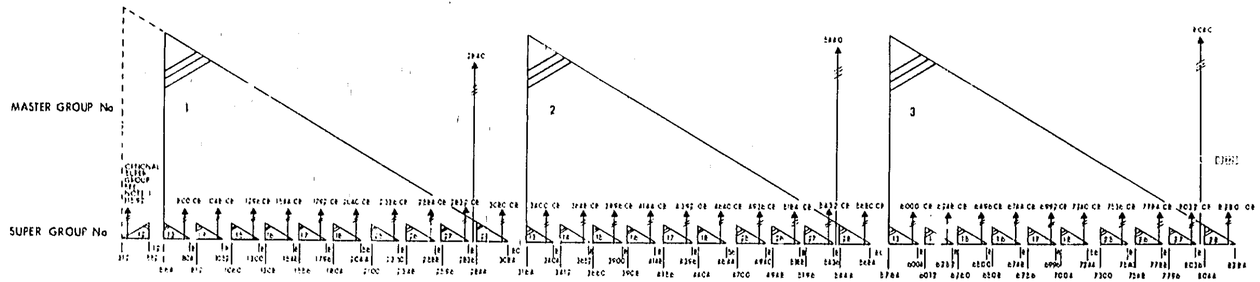
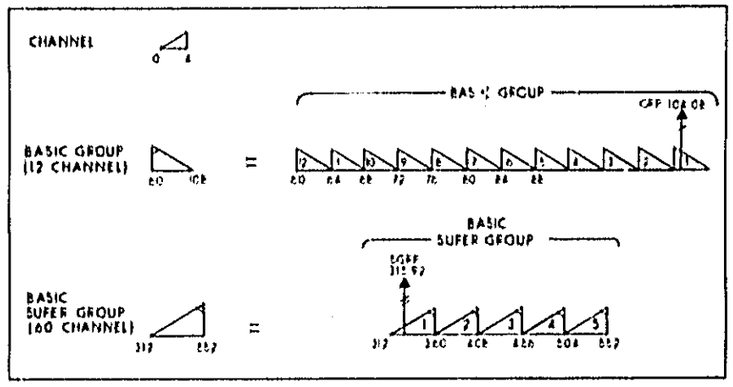


Figure 7-19 MMX–1C (L3) 1800/1860 Channels



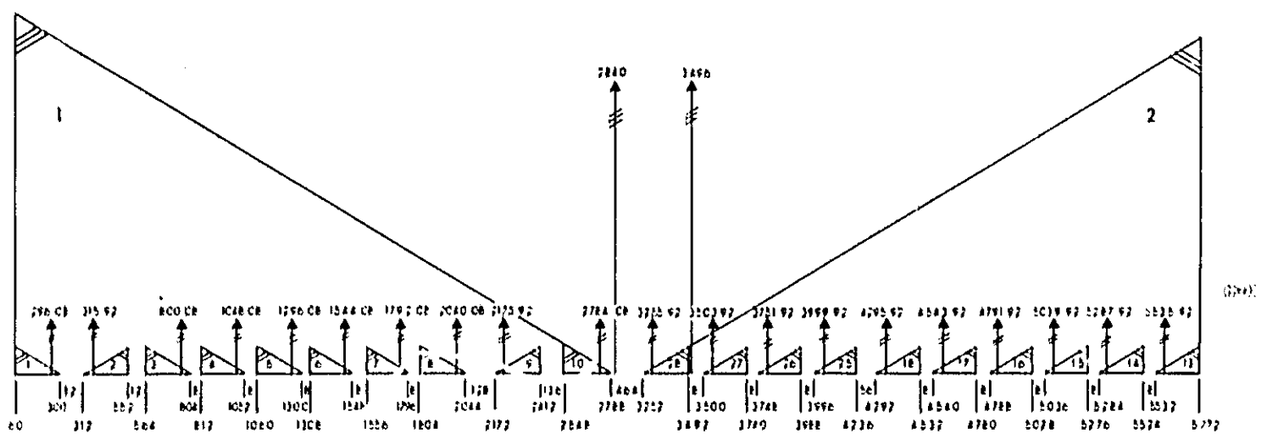
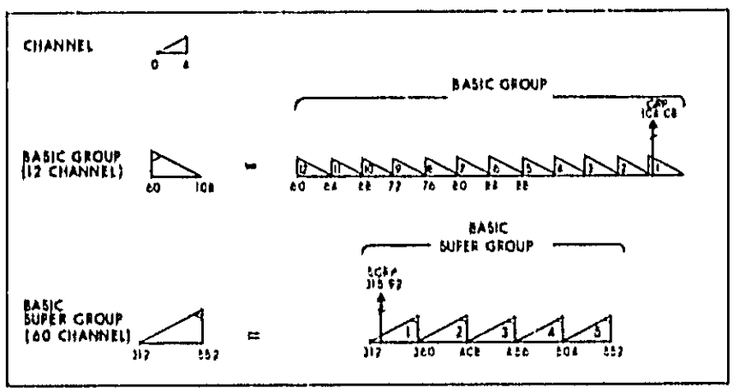


Figure 7-20 MMX-2R 1200 Channel



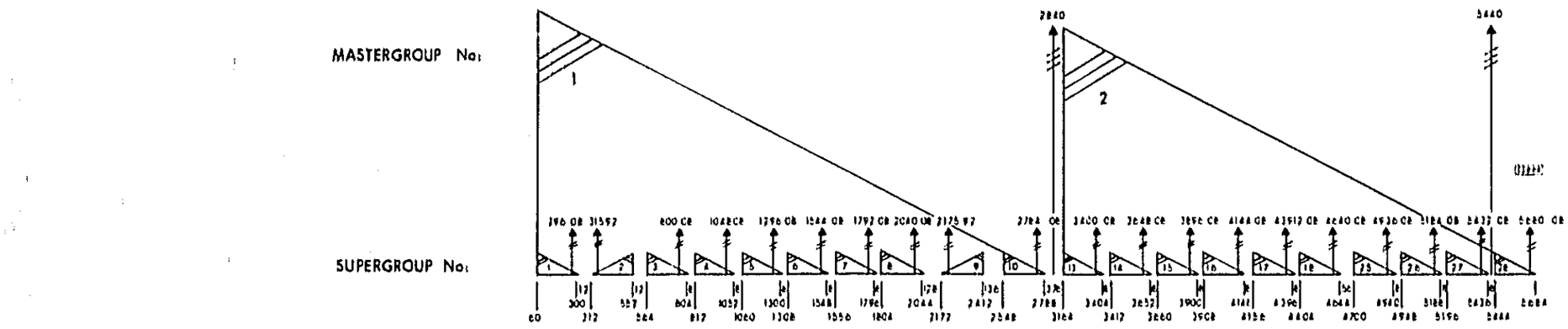


Figure 7-21 MMX–1R 1200 Channel

BACK DATING MANUAL CHANGES

SECTION VIII
MANUAL CHANGES

8-1 INTRODUCTION

8-2 This section containes information for adapting this manual to instruments for which the content does not apply directly.

8-3 MANUAL CHANGES

8-4 To adapt this manual to your instrument, refer to Table 8-1 and make the manual change listed for your instrument serial number.

8-5 If your instrument serial number is not listed on the title page of this manual or in Table 8-1, it may be documented in a MANUAL CHANGES supplement. For additional information about serial number coverage refer to INSTRUMENTS COVERED BY MANUAL in Section 1.

Table 8-1 Manual Changes

Serial Number Prefix	Make Change
2345U	A
2320U	A
2314U	A
2250U	A,B

CHANGE A

Page 6-17.
Delete step 73. BRIDGED-ALL INPUTS

CHANGE B

Pages 3-39/3-41.
Delete paragraphs 3-173 to 3-188.
Delete pages 5-3 to 5-6.
Add pages 5-3 to 5-6 as follows.

```
(CR) (LF)
SMG#MG# SG##G#CH#FREQ(KHZ) ##COUNT(KHZ) #LEVEL(DBM) #LIMITS###DATE#####TIME
(CR) (LF)
(CR) (LF)
```

(a) CCITT Plan Header

```
(CR) (LF)
####MG#SG##G#CH#FREQ(KHZ) ##COUNT(KHZ) #LEVEL(DBM) #LIMITS###DATE#####TIME
(CR) (LF)
(CR) (LF)
```

(a) BELL Plan Header

Where: (CR) = Carriage return
(LF) = Line feed
= Space

Notes: 1. All codes are transmitted as ASCII characters.

2. The SLMS sets the HP-IB signal line EOI true while the last character is being transmitted to indicate end of message.

Figure 5-1 80 Column Printer Message Header

```
#JJ#HH#SS#GG#CC#FFFFF.FFF##fffff.fff##LLLL.LL##WITHIN/##OUT###DD/MM/YY##HH:MM:SS
(CR)(LF)
```

(a) Format for all CCITT Plans

```
####HH#SS#GG#CC#FFFFF.FFF##fffff.fff##LLLL.LL##WITHIN/##OUT###DD/MM/YY##HH:MM:SS
(CR)(LF)
```

(b) Format for all Bell Plans

Where: JJ = Supermastergroup
HH = Hyper/Mastergroup
SS = Supergroup
GG = Group
CC = Channel
FFFFF.FFF = Counter Frequency
fffff.fff = Measurement Frequency
LLLL.LL = Level Measurement
# = Space
(LF) = Line Feed
(CR) = Carriage Return

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement will be replaced by spaces; eg if non-FDM measurements are being made then no FDM data will be sent.
4. Leading zeros in the frequency and level data will be replaced by spaces.
5. If the level measurement is a negative value, a - sign will precede the level measurement.
6. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-2 80 Column Printer Measurement Format

```
(CR) (LF)
SMG#MG  }
SMG#HG  } #SG##G#CH#FREQ(KHZ)##JITTER(DEG)###DATE######TIME
####MG  }
(CR) (LF)
(CR) (LF)
```

Header

```
#JJ#
####HH#SS#GG#CC#fffff.fff######22.22###DD/MM/YY##HH:MM:SS
(CR) (LF)
```

Measurement

Where:

JJ = Supermastergroup	fffff.fff = Measurement Frequency
HH = Hyper/Mastergroup	22.22 = Jitter Measurement
SS = Supergroup	# = Space
GG = Group	(LF) = Line Feed
CC = Channel	(CR) = Carriage Return

DD/MM/YY = Date as Day/Month/Year
HH:MM:SS = Time as Hours:Minutes:Seconds

Notes:
1. All characters are transmitted as ASCII codes.
2. The SLMS sets the HP-IB signal line EOI true while the last character in a string is being transmitted.
3. Parameters not defined in the current measurement are replaced by spaces; eg if non-FDM measurements are being made then no FDM data will be sent.
4. Leading zeros in the frequency and jitter data will be replaced by spaces.
5. FDM levels are all transmitted as 2 digit numbers with leading zeros where appropriate. FDM levels not defined in the current plan will be replaced by spaces.

Figure 5-3 — 80 Column Printer Phase Jitter Measurement Messages

SALES & SUPPORT OFFICES

Arranged alphabetically by country

UNITED STATES (Cont'd)

Nebraska
Hewlett-Packard
10824 Old Mill Rd., Suite 3
OMAHA, NE 68154
Tel: (402) 334-1813
CM,MS

New Jersey
Hewlett-Packard Co.
120 W. Century Road
PARAMUS, NJ 07652
Tel: (201) 265-5000
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
60 New England Av. West
PISCATAWAY, NJ 08854
Tel: (201) 981-1199
A,CH,CM,CS,E

New Mexico
Hewlett-Packard Co.
11300 Lomas Blvd.,N.E.
P.O. Box 11634
ALBUQUERQUE, NM 87112
Tel: (505) 292-1330
CH,CS,E,MS

New York
Hewlett-Packard Co.
5 Computer Drive South
ALBANY, NY 12205
Tel: (518) 458-1550
A,CH,E,MS

Hewlett-Packard Co.
9600 Main Street
P.O. Box AC
CLARENCE, NY 14031
Tel: (716) 759-8621
CH

Hewlett-Packard Co.
200 Cross Keys Office Park
FAIRPORT, NY 14450
Tel: (716) 223-9950
CH,CM,CS,E,MS

Hewlett-Packard Co.
7641 Henry Clay Blvd.
LIVERPOOL, NY 13088
Tel: (315) 451-1820
A,CH,CM,E,MS

Hewlett-Packard Co.
No. 1 Pennsylvania Plaza
55th Floor
34th Street & 8th Avenue
MANHATTAN NY 10119
Tel: (212) 971-0800
CH,CS,E*,M*

Hewlett-Packard Co.
250 Westchester Avenue
WHITE PLAINS, NY 10604
Tel: (914) 684-6100
CM,CH,CS,E

Hewlett-Packard Co.
3 Crossways Park West
WOODBURY, NY 11797
Tel: (516) 921-0300
A,CH,CM,CS,E,MS

North Carolina
Hewlett-Packard Co.
5605 Roanne Way
P.O. Box 26500
GREENSBORO, NC 27420
Tel: (919) 852-1800
A,CH,CM,CS,E,MS

Ohio
Hewlett-Packard Co.
9920 Carver Road
CINCINNATI, OH 45242
Tel: (513) 891-9870
CH,CS,MS

Hewlett-Packard Co.
16500 Sprague Road
CLEVELAND, OH 44130
Tel: (216) 243-7300
A,CH,CM,CS,E,MS

Hewlett-Packard Co.
962 Crupper Ave.
COLUMBUS, OH 43229
Tel: (614) 436-1041
Eff: Nov. 25, 1983
675 Brooksedge Blvd.
WESTERVILLE, OH 43081
CH,CM,CS,E*

Hewlett-Packard Co.
330 Progress Rd.
DAYTON, OH 45449
Tel: (513) 859-8202
A,CH,CM,E*,MS

Oklahoma
Hewlett-Packard Co.
304 N. Meridian, Suite A
P.O. Box 75609
OKLAHOMA CITY, OK 73147
Tel: (405) 946-9499
A*,CH,E*,MS

Hewlett-Packard Co.
3840 S. 103rd E. Avenue, #100
P.O. Box 35747
TULSA, OK 74153
Tel: (918) 665-3300
A**,CH,CS,M*

Oregon
Hewlett-Packard Co.
9255 S. W. Pioneer Court
P.O. Box 328
WILSONVILLE, OR 97070
Tel: (503) 682-8000
A,CH,CS,E*,MS

Pennsylvania
Hewlett-Packard Co.
111 Zeta Drive
PITTSBURGH, PA 15238
Tel: (412) 782-0400
A,CH,CS,E,MP

Hewlett-Packard Co.
2750 Monroe Boulevard
P.O. Box 713
VALLEY FORGE, PA 19482
Tel: (215) 666-9000
A,CH,CM,E,M

South Carolina
Hewlett-Packard Co.
Brookside Park, Suite 122
1 Harbison Way
P.O. Box 21708
COLUMBIA, SC 29221
Tel: (803) 732-0400
CH,E,MS

Hewlett-Packard Co.
Koger Executive Center
Chesterfield Bldg., Suite 124
GREENVILLE, SC 29615
Tel: (803) 297-4120

Tennessee
Hewlett-Packard Co.
224 Peters Road, Suite 102
P.O. Box 22490
KNOXVILLE, TN 37922
Tel: (615) 691-2371
A*,CH,MS

Hewlett-Packard Co.
3070 Directors Row
MEMPHIS, TN 38131
Tel: (901) 346-8370
A,CH,MS

Texas
Hewlett-Packard Co.
4171 North Mesa
Suite C-110
EL PASO, TX 79902
Tel: (915) 533-3555
CH,E*,MS**

Hewlett-Packard Co.
10535 Harwin Drive
P.O. Box 42816
HOUSTON, TX 77042
Tel: (713) 776-6400
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
930 E. Campbell Rd.
P.O. Box 1270
RICHARDSON, TX 75080
Tel: (214) 231-6101
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
1020 Central Parkway South
P.O. Box 32993
SAN ANTONIO, TX 78216
Tel: (512) 494-9336
CH,CS,E,MS

Utah
Hewlett-Packard Co.
3530 W. 2100 South
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
A,CH,CS,E,MS

Virginia
Hewlett-Packard Co.
4305 Cox Road
GLEN ALLEN, VA 23060
P.O. Box 9669
RICHMOND, VA 23228
Tel: (804) 747-7750
A,CH,CS,E,MS

Washington
Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
Tel: (206) 643-4000
A,CH,CM,CS,E,MP

Hewlett-Packard Co.
Suite A
708 North Argonne Road
SPOKANE, WA 99212
Tel: (509) 922-7000
CH,CS

West Virginia
Hewlett-Packard Co.
4604 MacCorkle Ave.
P.O. Box 4297
CHARLESTON, WV 25304
Tel: (304) 925-0492
A,MS

Wisconsin
Hewlett-Packard Co.
150 S. Sunny Slope Road
BROOKFIELD, WI 53005
Tel: (414) 784-8800
A,CH,CS,E*,MP

URUGUAY

Pablo Ferrando S.A.C. e I.
Avenida Italia 2877
Casilla de Correo 370
MONTEVIDEO
Tel: 80-2586
Telex: Public Booth 901
A,CM,E,M

VENEZUELA

Hewlett Packard de Venezuela C.A.
3RA Transversal Los Ruices Norte
Edificio Segre 1, 2 & 3
Apartado 50933
CARACAS 1071
Tel: 239-4133
Telex: 251046 HEWPACK
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