AN INTERNATIONAL SOUND PROGRAM CENTER (ISPC)

Aristidis Iliou Moschakis

A Major Technical Report

in

The Faculty

of

Engineering

Presented in Partial Fulfillment of the Requirements
for the degree of Master of Engineering at
Concordia University
Montréal, Quebec, Canada

September 1979

To the memory of my mother,
Zacharenia Moschakis

Abstract

AN INTERNATIONAL SOUND PROGRAM CENTER (ISPC)

Aristidis Il[illegible]u Moschakis

This is a technical report on the International Sound Program Center, which was designed and developed to meet the program transmission requirements of the 1976 Olympic Games, from Montreal to overseas.

For the benefit of the reader some basic principles on transmission have been explained in Chapter II. Also, an attempt was made to describe and highlight all the technical parameters taken into consideration in the preliminary and final design stages.

Furthermore, the economics and the technical problems faced with in the process of developing this project have been elaborated. The answers to these problems from an engineering point of view, have been treated in simple language and when necessary tables and figures or drawings are provided.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude and appreciation to Dr. V.K. Bhargava for accepting this project and for the guidance provided during the preparation of this report.

Furthermore, the close supervision and guidance of the Graduate Studies Director Dr. V. Ramachandran as well as that of Dr. S. Morgera during the preparation of the defence of this report, have appreciably contributed to the consolidation of my knowledge regarding the background theory and principles of the project.

My thanks also extend to the Chairman of the Department of Electrical Engineering Dr. Andreas Antoniou for taking the time to chair the examining committee during my oral defence.

In addition, I would like to thank Teleglobe Canada and in particular Mr. Robert Séguin, Vice-President, Engineering and System Development, for authorizing me to use one of my projects at Teleglobe and the material associated with it, for the topic of my major technical report.

I would also like to take the opportunity to thank my father Ilias, for the encouragement he has given me throughout my studies.

Montreal, Quebec
September 1979

Aristidis Iliou Moschakis

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURE		Page

LIST OF DRAWINGS

CHAPTER I

GENERAL

1.1 SCOPE

The object of this paper is to enable the reader to understand the realization of the project by stating and documenting the information and specifications associated with it. Some basic principles and concepts are explained as background material to the development and design considerations of the International Sound Program Center (ISPC). The system was made for the Montreal gateway terminal as an integral part of the overall network facilities established by Teleglobe-Canada for the transmission overseas of the 1976 Montreal Olympics.

The system was capable of carrying the ultimate simultaneous programs sent to the terminal of Teleglobe, by the Olympic Radio Television Organization (ORTO), the exclusive distributing agent for the games.

All programs coming to ISPC from ORTO were manually fed to the channel translating equipment for their final destination overseas.

1.2 INTRODUCTION

The International Sound Program Center (ISPC) was designed and developed in order to handle the relatively heavy load of simultaneous programs transmitted overseas during the 1976 summer Olympic games from

Montreal.

The ISPC could be compared to a complex switch linking two main points; that is, the broadcast studios of ORTO (Olympic Radio-Television Organization) as one end point and the overseas transmission equipment of Teleglobe as the other end point.

The first part of the link was made by using a special type of circuits called "triplets" between the control room of ORTO and the ISPC room of Teleglobe.

There was a total of 225 triplets and 25 pairs of control circuits, between these two points. Each triplet consists of three loops, one wide band 5 KHz (Tx-only) and two narrow band 2.7 KHz (Tx and Rx). (Ref. Telegloble Drawing No. BP5/D/4.3/1).

The second part of the link was made directly to the overseas transmission equipment depending on the type of message contained in the loop. That is, messages coming in the 5 KHz loop were fed to the channel banks via an MIB (Music in Band), and the messages coming in the narrow band were fed directly to the channel banks, for transmission overseas.

CHAPTER 2

MULTIPLEX SYSTEMS

2.1 SIGNAL MULTIPLEXING

Multiplexing in transmission systems is a means of utilizing the same transmission medium for many different users. Before being placed on the transmission medium, each user's signal may have to be modified in some unique way so that it can be separated from all of the other signals at the opposite end of the transmission path. This separation involves basically the inverse of the original modification.

The individual voice signals $m_1(t)$, $m_2(t)$ . . . . $m_n(t)$, are applied to individual modulators, each modulator being supplied as well with carrier waveforms of frequency f_1, f_2, ... f_n.

A modulator unit along with its counterpart (demodulator unit) is the basic building block of a *Frequency Division Multiplex System.*

The individual modulator output signals extend over a limited range in the neighbourhood of the individual carrier frequencies. Most importantly, the carrier frequencies are selected so that the spectral ranges of the modulator output signals do not overlap. This separation in frequency is precisely the feature that allows the eventual recovery of the individual signals, and for this reason this type of multiplexing system is referred to as *Frequency Division Multiplexing.*

To facilitate this separation of the individual signals, the carrier frequencies are selected to leave a comfortable margin, 'Guard Band', between the limit of one frequency range and the beginning of the next.

The composite signal, i.e. the combined output of all the modulators, is then applied to a common communications channel.

At the receiving end, the composite signal is applied to each of group of bandpass filters whose passbands are in the neighbourhood f_1, f_2 . . . . . . f_n. The filter f_1 is a bandpass filter which passes only the spectral range of the output of the modulator and similarly for the other bandpass filters. The signals have thus been separated. They are then applied to individual demodulators which extract the baseband signals from the carrier.

2.2 CHANNEL TRANSLATING EQUIPMENT

A brief general description, identifying each of the translating stages of the multiplexing system is presented in this section. This multiplex system is capable of translating or accommodating up to 600 simultaneous voice frequency telephone conversations (300 Hz - 3400 Hz), in the frequency band of 60 KHz - 4028 KHz in the following sequence.

The channel translating equipment translates twelve voice frequency channels of 4 KHz (300 Hz - 3400 Hz) nominal bandwidth into the basic group (60 KHz - 108 KHz) and vice versa. Briefly, in the transmit transmission path, three of the 4 KHz voice frequency bands modulate respectively three carriers of 12, 16, and 20 KHz. Their outputs are combined to give the basic three channel pregroup in the band of 12 KHz - 24 KHz.

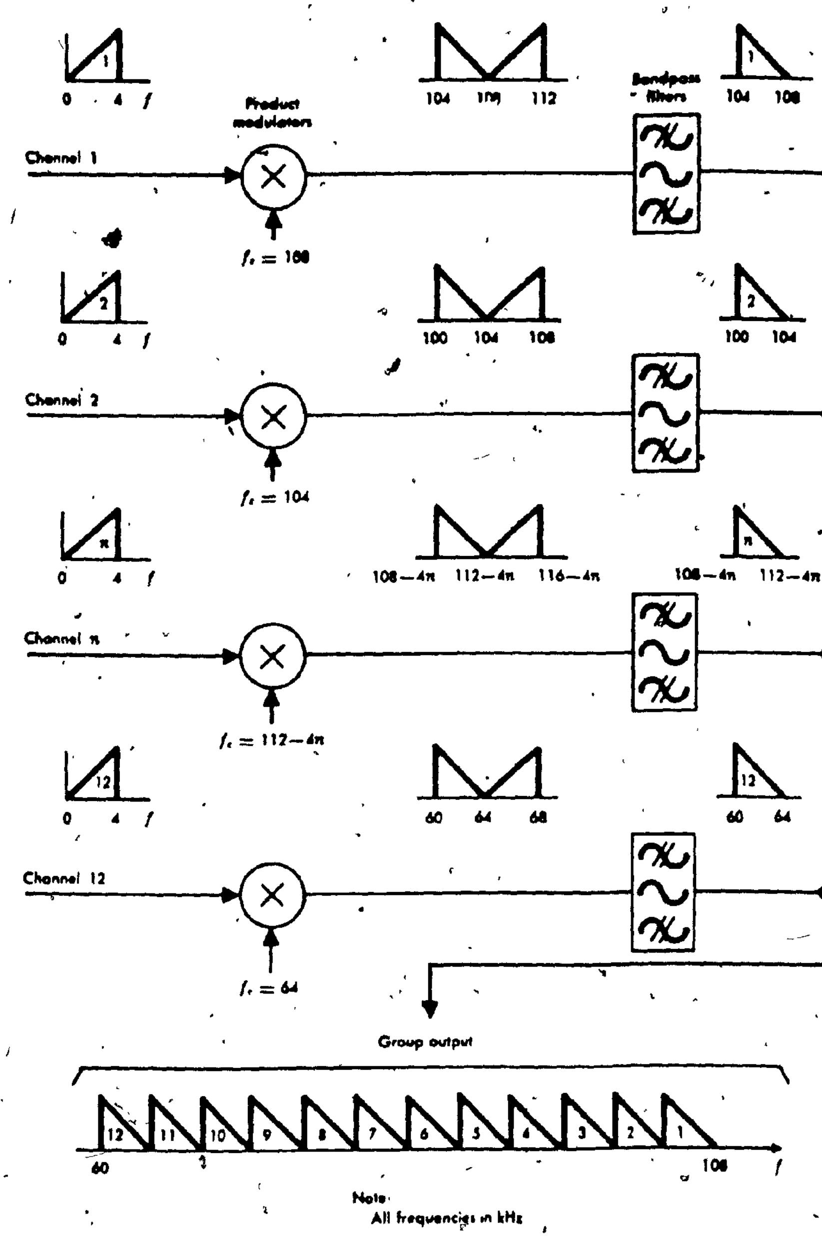


Fig. 2.1 - Basic group with A-type channel bank.

Four such pregroups modulate in turn 84, 96, 108 and 120 KHz carriers and the outputs are combined to give the basic group band of 60 KHz - 108 KHz. Exactly the reverse process takes place in the receive transmission path.

The composition of the 12 channel group is shown in Fig. 2.1. The slope of each message channel indicates sideband orientation with respect to audio frequency; i.e. highest amplitude represents the highest audio frequency. Note that the group is formed by taking channel n (for n = 1 to 12) and having it modulate a carrier at a frequency of 112 - 4n KHz. The lower sidebands are then selected by filtering and combined. The result is the group of 12 inverted sidebands in the previously mentioned frequency range of 60 KHz to 108 KHz, thus forming the 'channel bank'.

2.3 The Group Translating Equipment

In the group translating equipment the next stage of multiplexing takes place. The outputs of five 'channel banks' each in the basic group frequency band 60 KHz to 108 KHz, modulate five carriers of 420 KHz, 468 KHz, 516 KHz, 564 KHz, and 612 KHz, respectively to assemble the 312 KHz to 552 KHz frequency band which is the basic supergroup.

In other words, five channel banks with 12 channels each at the frequency band of 60 - 108 KHz, modulate the five carriers and the resultant is a 'Group Bank' containing 60 channels in the frequency band of 312 KHz - 552 KHz.

The above is accomplished in the group bank as shown in Fig. 2.2, where the n^{th} group (for n = 1 to 5) modulates a 372 + 48 n KHz carrier.

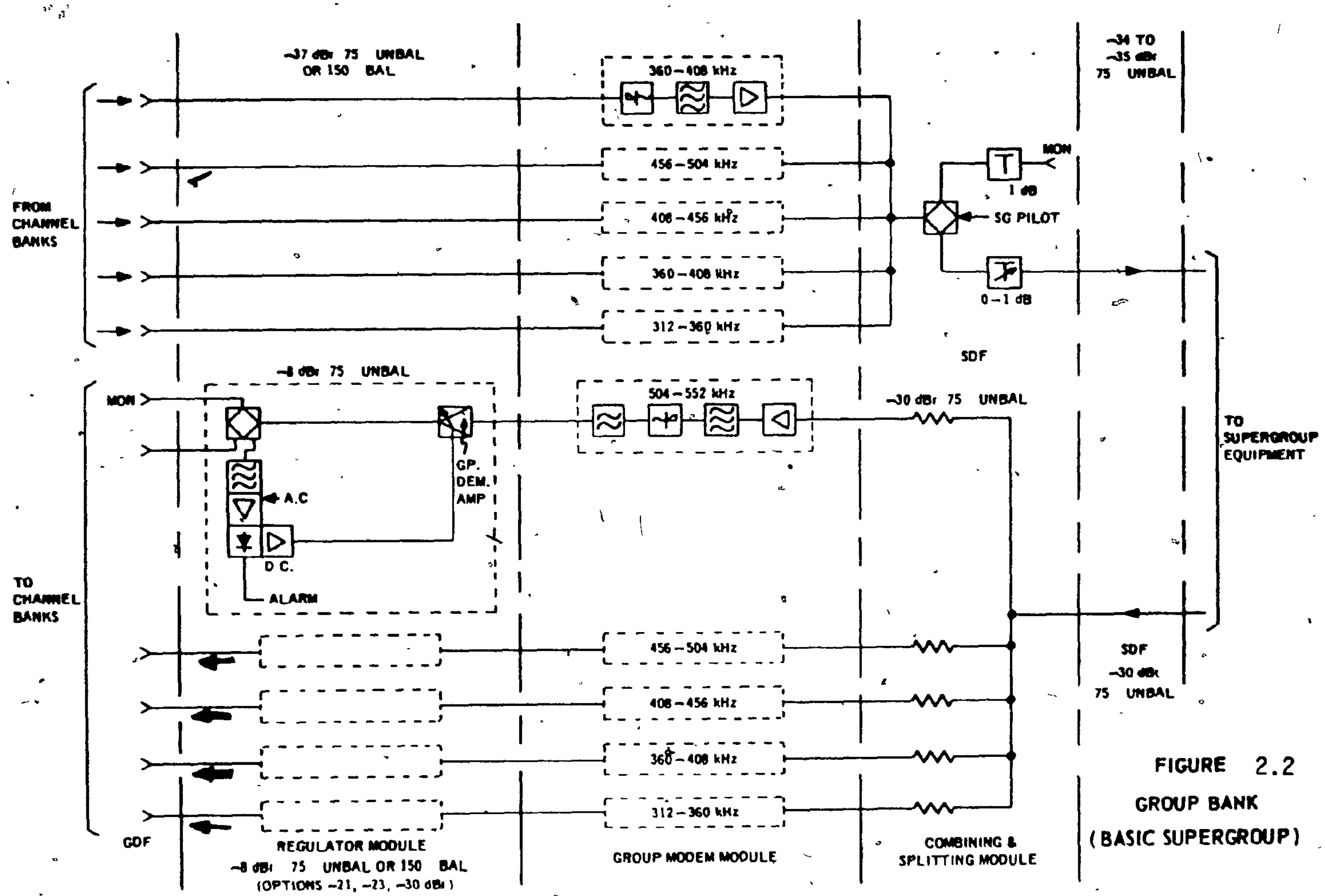


FIGURE 2.2

GROUP BANK

(BASIC SUPERGROUP)

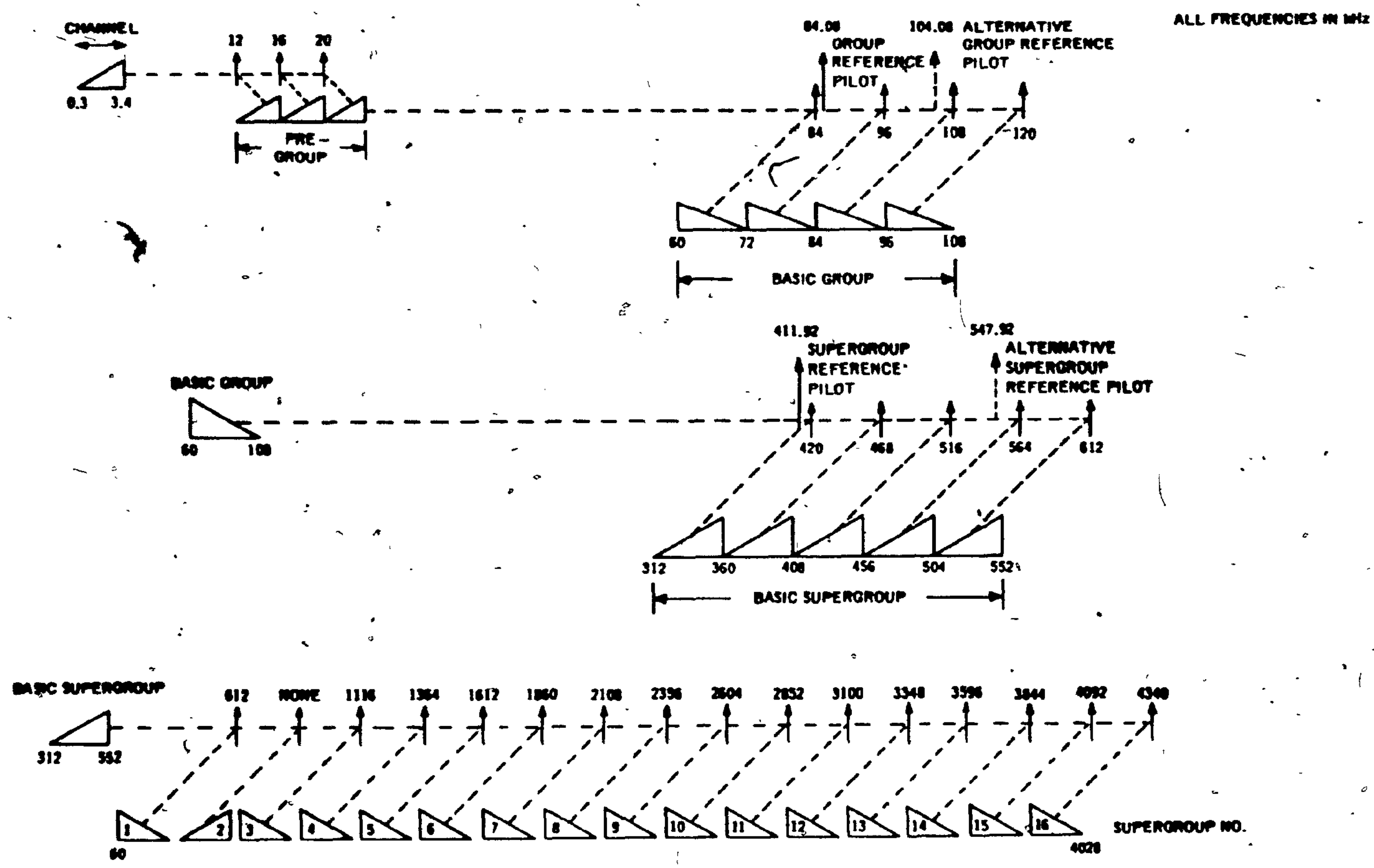


Fig. 2.3 — MULTIPLEX MODULATION SCHEME (960 CH. SYSTEM)

SHEET 1 OF 2

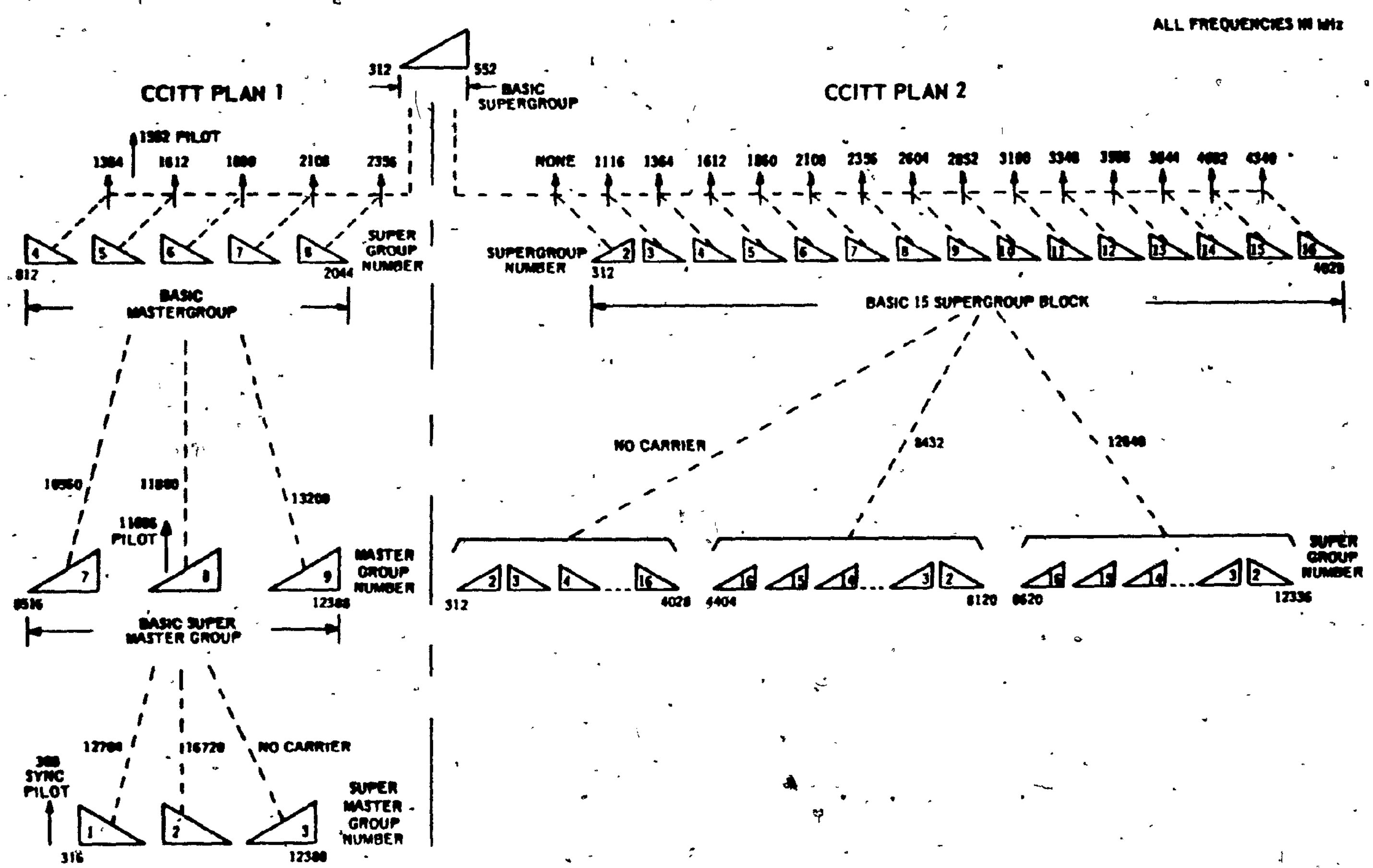


Fig. 2.3 — MULTIPLEX MASTERGROUP MODULATION SCHEME
(cont'd)

SHEET 2 OF 2

2.4 THE SUPERGROUP TRANSLATING EQUIPMENT

The required system configuration will, in general, determine how the supergroup translating equipment is to be applied if particular system requirements are to be satisfied. The equipment provides for the translation of up to sixteen group bank outputs in the frequency band of 312 KHz to 552 KHz.

Fifteen carrier freouencies are used to modulate each of fifteen basic supergroup inputs (Group Bank Outputs) to provide supergroup 1 and supergroup 3 to 16. Supergroup 2 is derived from an unmodulated basic supergroup. The outputs of each of the translating equipment are combined to yield a baseband line frequency band of 60 KHz - 4028 KHz. Exactly the reverse process takes place in the receive direction.

We have so far examined the three major stages of multiplexing; there are further multiplexing stages such as the translation of the supergroups into the "Master-Group", as well as the translation of the "Master Groups" into the "Super Master Group".

Because of their similarity and nature of technique with the previous stages we have described, and because in the project described in this paper we are dealing with multiplexing stages up to the "supergroup" level only, we shall not go into further details.

In Fig. 2.3 it is shown how the basic supergroup or "Group-Bank" is further multiplexed to the "Super-Group-Bank" which consists of 960 audio frequency channels at the frequency band of 60 KHz - 4028 KHz. In the same figure it is also shown how the previous stages of multiplexing are formed; from the voice frequency channel all the way through, to the supergroup level, indicating also the carrier frequencies at all stages as well as the reference pilots at the different stages.

2.5 SINGLE-SIDEBAND SUPPRESSED CARRIER

The most widely used modulation technique in frequency-division multiplexing is the single-sideband suppressed carrier (SSBSC).

When a carrier is amplitude-modulated by a signal, two sidebands are produced both containing the intelligence. Therefore, both sidebands are not required in order to transmit the message.

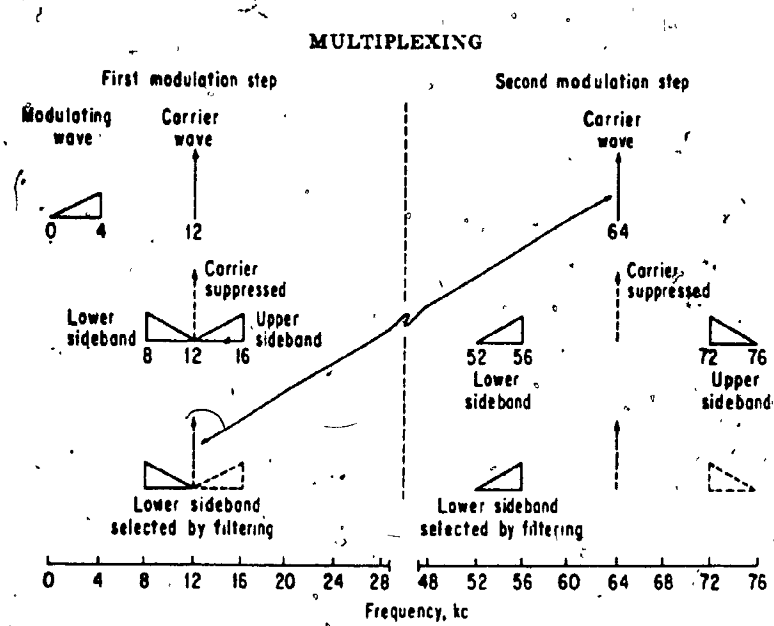


Fig. 2.4 — In SSBSC modulation, the carrier and one sideboard are removed during each modulation step.

A balanced modulator is used to suppress the carrier, leaving only the two sidebands. This reduces the power of the signal by one-half but does not suppress one of the sidebands. Sideband suppression is accomplished by applying the signal to a filter which passes only one of the sidebands while effectively attenuating the other. The bandwidth of the signal is now approximately equal to the original voice-frequency signal, that is, about 3100 Hz. Further bandwidth reduction, therefore, is not possible without lowering the quality of the signal. Fig. 2.4 illustrates two typical SSBSC modulation steps used to shift one voice-frequency signal to a carrier-frequency channel.

From a practical point of view, there is still a slight amount of wasted bandwidth because of the imperfect characteristics of the channel filters, as shown in Fig. 2.5.

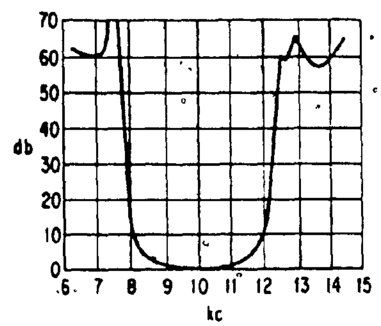


Fig. 2.5 — Typical attenuation-frequency characteristic of a voice channel in a multiplex system.

A perfect filter would have vertical sides in its frequency-amplitude characteristics, thus passing all frequencies within its passband perfectly while completely attenuating all outside the passband frequencies. The interference that might be caused by imperfect performance of filters is avoided by the standard practice of the guard-band used with the SSBSC systems. Although the standard spacing is 4 KHz per channel, the effective bandwidth of voice signals is approximately 3.1 KHz.

In spite of the complicated transmission problems, the SSBSC modulation technique is very commonly used world-wide because of the great economies it offers in bandwidth as well as transmitted power.

2.6 CARRIER FREQUENCY GENERATION

The method used in generating carrier and pilot supplies for the multiplex equipment used differs from the traditional harmonic generation method by which harmonics of a stable source frequency generator were selected by means of filters.

The MA-5A carrier supply system is based on the principle that all carrier frequencies are generated by individual oscillators and synchronized to a stable reference source by the impulse governed oscillator technique. By using as many impulse governed oscillators as there are carrier frequencies, a complete carrier supply system, whose frequencies are as accurate and stable as the reference source, may be economically built up as required. The carrier supply osciallators are contained in plug-in modules and may be arranged in hot-standby pairs if desired.

The standby module is switched into service, in the event of a failure in the unit which normally supplies the equipment, in a time of less than five milliseconds.

The carrier frequency generating equipment is provided with its own distribution facilities which can be supplied as required and which facilitate multisystem operation. The distribution system is capable of supplying twelve bays of channel translating equipment, i.e. 3600 channels. More details of the carrier supply system are shown in Fig. 2.6 and Fig. 2.7.

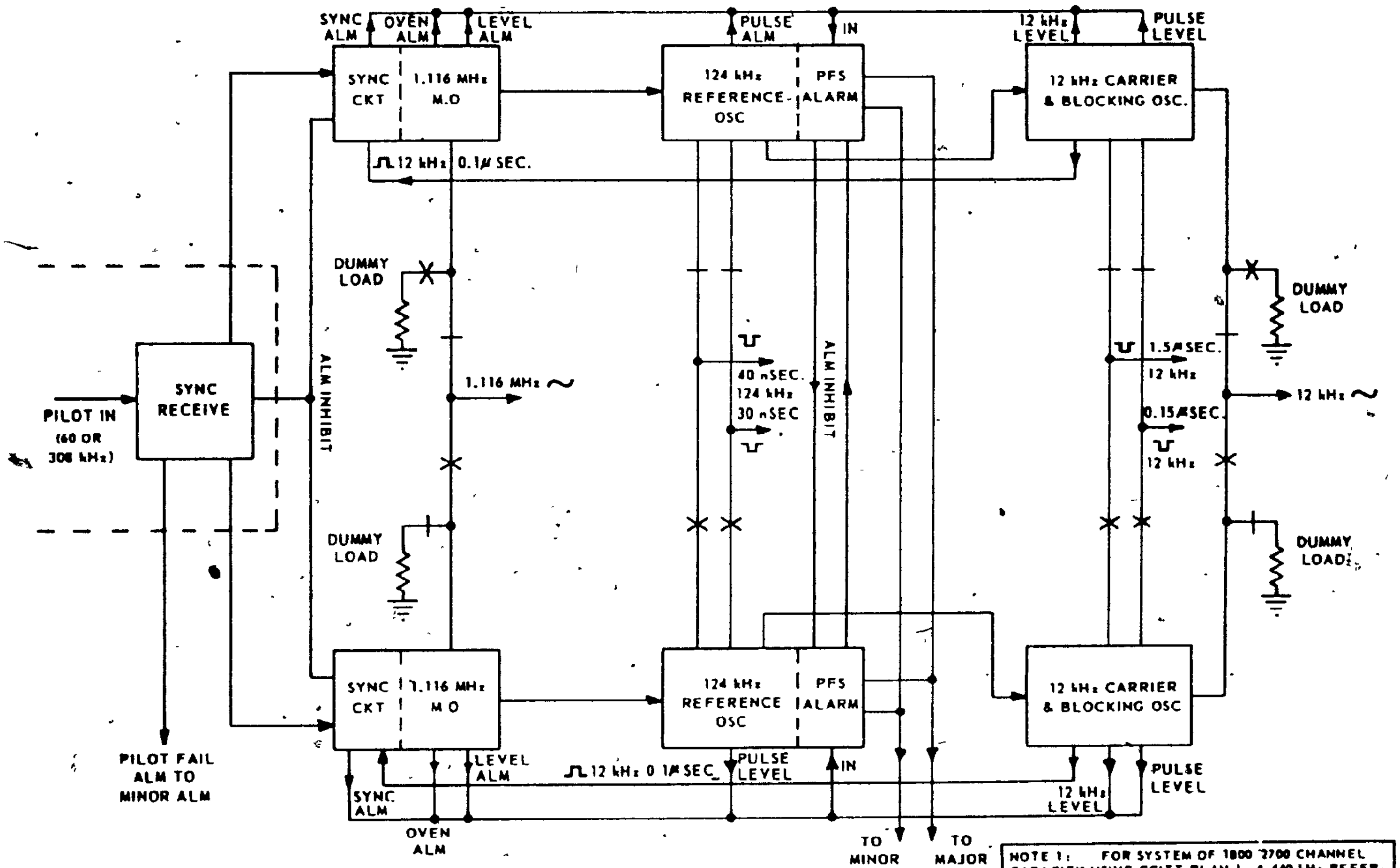


Fig. 2.6 - PRIMARY FREQUENCY SUPPLY
NORMAL & STANDBY SYSTEM (960 CH SYSTEM)

NOTE 1: FOR SYSTEM OF 1800 2700 CHANNEL CAPACITY USING CCITT PLAN 1 - A 440 kHz REFERENCE OSCILLATOR IS USED TO DERIVE THE MASTERGROUP AND SUPERMASTERGROUP CARRIER FREQUENCIES

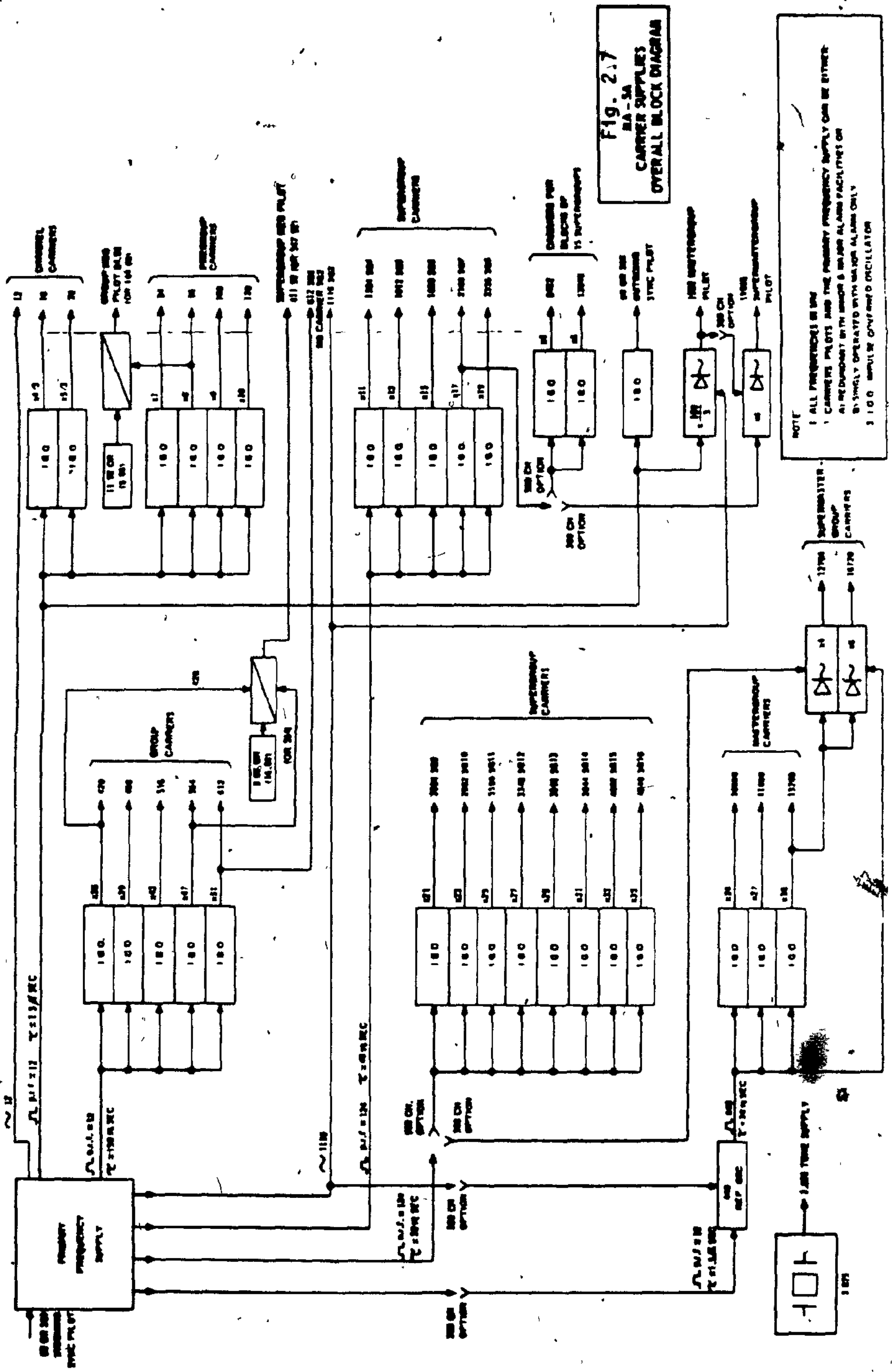


Fig. 2.7
RA-3A
CARRIER SUPPLIES
OVERALL BLOCK DIAGRAM

2.7 PILOTS

Pilots are auxiliary signals employed in multiplex systems for such functions as Level Regulation, Frequency Synchronization, Alarm Systems and Maintenance Monitoring. The transmit line levels at multiplex terminals and at repeaters must be maintained within close tolerances. Line noise and crosstalk from adjacent systems increase if the level is too low, while too high a level causes overloading which can result in intermodulation distortion and crosstalk into other systems. Regulating pilots are used to operate compensating devices throughout the multiplex system in order to control line levels.

Frequency synchronization pilots are often used to maintain end-to-end frequency stability. This is especially important in SSBSC systems, where the line carrier frequency must be reinserted at the receiving terminal, and for systems carrying telegraph and high speed data. Frequency synchronization is accomplished by phaselocking the carrier frequencies in one terminal with the carrier frequncies at the opposite terminal by means of one or more pilots transmitted in the system. Thus, if the carrier frequencies at the transmit terminal begin to drift, the respective carrier frequencies at the receive terminal will drift a like amount.

The frequency of the pilots and the number required in each multiplex system depend mainly upon the particular frequency-allocation and modulation plan and, of course, any special needs of the system. Pilots are normally transmitted at a level 10 db to 20 db below the system's test-tone level (TTL).

2.8 SYNCHRONIZATION AND PILOTS

Adequate frequency relationship between the transmitter and the receiver depends upon the carrier which is modulated by the message signal. To maintain the adequacy of frequency relationship, two basic methods are commonly used. Both require a pilot frequency to be transmitted with the outgoing signal. This pilot frequency undergoes whatever frequency translations or phase shifts are imposed on the various information channels.

In one method of frequency control, this transmitted pilot is used to modulate a local oscillator in the receiver to obtain the carrier frequencies used in demodulating the information channels. If the transmitted signals, including the pilots, have undergone additional modulation steps or other frequency changes during transmission this method cancels the errors out, leaving only the possibility of a fixed error between the transmitter and receiver local oscillators. This error, of course, can be eliminated by simply adjusting the frequency of the load oscillator.

The second method of frequency control requires the use of a transmitted pilot frequency. This pilot is used as an absolute frequency and phase reference. At each receiver, a single "master" oscillator may be used, and all channel carriers and a local pilot frequency are derived from it. Both the transmitted pilot and the locally generated pilot frequency are compared in a phase discriminator circuit. Any phase or frequency difference between the two results is an error voltage being generated in the output of the discriminator. This error voltage is then applied to the master oscillator to 'pull' the oscillator frequency, thus correcting the local pilot frequency. Since all local carriers are derived from this oscillator, changes in its frequency which correct differences between the incoming and the local pilot also remove any frequency or phase errors between the transmitted and local carrier frequencies.

2.9 Group and Supergroup Pilots

A group pilot frequency is supplied at 84.08, 92.0 or 104.8 KHz for in-service monitoring of system levels and performance. A line pilot is supplied at 32, 60, 64, 308 or 564 KHz for monitoring and frequency synchronization.

Each pilot-controlled group amplifier regulates the output level, at pilot frequency to within ± 0.25 db of nominal level, for input level variations of ± 4 db. The group regulating pilot used in our equipment is that recommended by the CCITT which is 84.08 KHz or 104.08 KHz. The 104.08 KHz pilot is used for wide-band data applications. The level of the pilot is -20 dbm. A supervising facility is also provided with the pilot, and input variations of 5 ± 1 db or more will initiate a minor alarm output. If the pilot level at the output of the regulator drops by 7 ± 1 db or more, with respect to nominal, the regulation circuitry will be automatically switched to the condition which is equivalent to the nominal gain of the amplifier. This prevents the introduction of excess gain into the system when the incoming pilot fails. A major alarm will be initiated under these circumstances.

For the supergroup CCITT-recommended pilots of 411.92 KHz or 547.92 KHz at a level of -20 dbmo are supplied; the 547.92 KHz pilot being intended for use on wideband data systems. These pilots are utilized in the automatic regulation circuitry which is optionally available as an integral part of the supergroup demodulation amplifier and for the provision of alarm features as recommended by the CCITT. The automaticallyregulated supergroup demodulation amplifiers maintain the receive level constant within ± 0.25 db for line variations within ± 4 db. The supergroup demodulation amplifier which incorporates automatic regulation has the same basic alarm features as those described for the group demodulation amplifier with the exception that, where redundant supergroup amplifiers are provided, a drop in pilot level output of 7 ± 1 db will cause switchover to standby to take place and only a minor alarm will be generated.

2.10 LOADING EFFECTS

a) Intermodulation Distortion

Intermodulation distortion occurs when traffic is so great as to overload the amplifiers or exceed the design rating of the modulators and associated circuit elements. Present-day multiplex systems carry many voice frequency channels that are handled by common amplifiers, modulators, and demodulators which are not perfectly linear. Often instead of distorting only the impressed signal, the entire multiplex system overloads, resulting in background noise and crosstalk that increases as the system load becomes greater. In some cases, crosstalk may even be intelligible. In some large systems, however, most distortion appears only as random noise which reduces the signal-to-noise ratio.

Distortion increases significantly when large signal voltage peaks drive some element in the system beyond its region of linear operation.

When the signal voltage exceeds the break-point of the amplifier, sufficient higher-order intermodulation products are generated to cause interference in most or all of the channels in the system.

In reducing the effects of interference, it is necessary to maintain the signal level as high as possible without causing overload.

b) Speech Loading

The speech signals are more complicated than telegraph tones and data signals. Each signal consists of a variety of frequencies and a great range of amplitudes. In telephone multiplex systems, many factors influence the load on the system. Some of the more important include speech habits of the telephone user, hourly variations in system use, the psychological effect on the spearker of the circuit quality, and the technical characteristics of the subscriber's equipment and load telephone plant. Telephone company practice has been to design communication systems for a 'break' point of 1 per cent of the busiest period. In normal telephone practice, the total average input voltage (or power level) to the carrier system is set so that the overload or break point is not reached more than 1 per cent of the busiest hour. Since the voltage distribution varies with the number of talkers using a system, the amount of average signal level must be reduced (the peak factor) will vary with the size of the system.

c) Telegraph and Data Loading

The channel capacity and transmission levels for a multiplex system are stated in terms of voice circuits, referenced to the rms value of a test tone (usually 1000 Hz or 800 Hz). Because of their narrow bandwidth however, up to about 26 ordinary telegraph or data signals can be applied to a single voice channel of a multiplex system. These multiple-tone signals have a greater average power than a voice signal, therefore, a loading factor must be considered.

In the calculation of the loading effect of a multiple-tone signal, peak power is used. As the number of telegraph or data signals is increased, the potential peak power level that the composite signal may reach also increases, even though the rms level is held constant by lowering the level of the individual tones. To avoid the possibility of peak overloading, a 'peak factor' is used when the maximum permissible level of multitone signals applied to a single voice channel is calculated. The absolute peak factor is expressed as:

$$\text{Absolute} = \text{Peak factor (in db)} = 3 + 10 \log N$$

where N is the number of single tones. Thus, for a single tone, the absolute peak factor is 3db. Since the absolute peak factor can become quite high, it is not practical to build high-density multiplex systems that are completely free from the possibility of peak overloading.

CHAPTER III

SYSTEM DEVELOPMENT

3.1 CIRCUIT REQUIREMENTS

The task of the provision of the facilities to handle the audio circuit requirements for the 1976 Olympics was the responsibility of the Engineering Department. It has been established that the total voice frequency (VF) circuits 2.7 KHz requirements were:

216	one-way	(send)	circuits
160	one-way	(receive)	circuits

These circuits were classed as 'program' circuits and therefore the total quantity of two-way VF channels needed to satisfy this requirement was 376 channels. This was the figure used as the basis for the development of tha "Model Network".

Table 3A contains a complete breakdown of the telephone, telegraph and leased circuit requirements for the years 1976 and 1978 on a country by country and route by route basis. The information contained in the tables was obtained from the P1/74 report of the department of operations.

Table 3B contains an estimate of the number of circuits per country required for broadcast use of the Olympic games for a total of about 123 countries, participating in the games. That table provided what was called

TABLE 3A: SUMMARY OF CIRCUIT QUANTITIES AS GIVEN IN REPORT P1/74

	1976				1978			
Country	**Tel**	**Tg**	**Leased**	**Total**	**Tel**	**Tg**	**Leased**	**Total**
Lake Cowichan								
- Australia(Mtl)	14	1	0	15	14	1	0	15
- Australia(Vcr)	8	0	2	10	14	0	3	17
- China	1	1	0	2	1	1	0	2
- Fiji	2	0	0	2	2	0	0	2
- Hawaii	8	0	1	9	12	0	2	14
- Hong Kong	11	1	1	13	16	1	2	19
- Japan	8	0	3	11	22	0	4	26
- South Korea	4	0	0	4	5	0	1	6
- Malaysia	3	0	0	3	3	0	0	3
- New Zealand	3	0	1	4	5	0	1	6
- Philippines	5	0	0	5	6	1	1	8
- Singapore	7	1	1	9	9	1	1	11
TOTALS	75	4	9	88	110	5	15	130
Mill Village-1 (Mj)								
- Barbados	7	0	2	9	0	0	0	0
- Brazil	14	0	1	15	17	0	2	19
- France	5	1	1	7	5	1	2	8
- W. Germany	0	0	0	0	24	0	0	24
- Italy	0	0	0	0	24	0	0	24
- Jamaica	37	1	5	43	0	0	0	0
- Lebanon	5	0	0	5	6	0	1	7
- Trinidad	9	1	2	12	0	0	0	0
- United Kingdom	28	2	4	34	41	3	4	48
- USSR (Russia)	6	0	1	7	8	0	1	9
TOTALS	111	5	16	132	125	4	10	139
Mill Village-2 (Pri)								
- Austria	4	0	0	4	10	0	1	11
- Barbados	0	0	0	0	14	0	3	17
- Belgium	5	0	1	6	9	0	1	10
- Cayman Islands	0	0	0	0	0	1	0	1
- Czechoslovakia	4	0	0	4	4	0	0	4
- W. Germany	24	1	1	26	4	1	1	6
- Greece	17	1	1	19	24	1	1	26
- Hungary	4	0	0	4	5	0	1	6
- Israel	7	0	0	7	7	0	1	8
- Italy	20	1	1	22	5	1	2	8
- Jamaica	0	0	0	0	60	1	7	68
- Netherlands	9	1	1	11	12	1	1	14
- Poland	5	0	0	5	6	0	1	7
- Portugal	6	0	0	6	7	0	0	7
- Scandinavia	11	2	1	14	16	2	1	19
- South Africa	5	0	1	6	8	0	1	9
- Spain	2	1	1	4	3	1	1	5
- Switzerland	7	1	1	9	10	1	1	12
- Trinidad	0	0	0	0	24	1	4	29
- United Kingdom	28	2	3	33	41	2	4	47
- Venezuela	13	0	1	14	17	1	2	20
- Yugoslavia	10	0	1	11	11	0	1	12
TOTALS	181	10	14	205	29[illegible]	14	35	346
Compac								
- Australia(Mtl)	46	1	0	47	46	1	0	47
- Australia(Vcr)	24	2	1	27	27	2	1	30
- Hawaii	13	2	0	15	13	2	0	15
- Hong Kong	3	1	0	4	3	1	0	4
- Japan	13	2	0	15	13	2	0	15
- Malaysia	1	0	0	1	1	0	0	1
- New Zealand	4	1	0	5	4	1	0	5
- Philippines	5	0	0	5	6	0	0	6
- Taiwan	3	0	0	3	3	0	0	3
TOTALS	112	9	1	122	116	9	1	126
TAT-1								
- France	16	0	0	16	16	0	0	16
- United Kingdom	6	2	0	8	6	2	0	8
TOTALS	22	2	0	24	22	2	0	24

TABLE 3A - CONT'D.

Country	1976 Tel	1976 Tg	1976 Leased	1976 Total	1978 Tel	1978 Tg	1978 Leased	1978 Total
Cantat-2 (Mtl)								
- Austria	8	1	1	10	7	1	1	9
- Belgium	12	1	1	14	15	1	1	17
- East Africa	4	0	0	4	6	0	1	7
- France	27	1	3	31	48	2	4	54
- Germany	14	2	2	18	15	2	3	20
- Greece	13	0	1	14	12	0	2	14
- India	7	1	1	9	10	1	1	12
- Ireland	13	0	1	14	9	0	1	10
- Israel	7	0	1	8	14	0	1	15
- Italy	9	0	1	11	19	0	3	22
- Netherlands	10	0	1	11	14	0	2	16
- Portugal	5	1	1	7	2	1	1	4
- Scandinavia	16	2	1	19	17	2	2	21
- South Africa	3	1	0	4	3	1	0	4
- Spain	11	0	1	12	14	0	1	15
- Switzerland	14	1	1	16	19	2	2	23
- United Kingdom	48	1	9	58	37	2	11	50
TOTALS	221	12	27	260	261	15	37	313
Cantat-2 (Tor)								
- Austria	4	0	0	4	5	0	0	5
- Belgium	4	0	0	4	5	0	0	5
- France	11	0	0	11	19	0	0	19
- Germany	27	0	0	27	40	0	0	40
- Greece	9	0	0	9	12	0	0	12
- Ireland	0	0	0	0	7	0	0	7
- Israel	5	0	0	5	9	0	0	9
- Italy	20	0	0	20	30	0	0	30
- Netherlands	10	0	0	10	14	0	0	14
- Portugal	0	0	0	0	7	0	0	7
- Scandinavia	6	0	0	6	8	0	0	8
- Spain	3	0	0	3	4	0	0	4
- Switzerland	8	0	0	8	10	0	0	10
- United Kingdom	104	0	0	104	158	0	0	158
TOTALS	211	0	0	211	328	0	0	328
Terrestrial								
- Argentina	13	1	1	15	17	1	2	20
- Bahamas	0	0	0	0	0	1	0	1
- Barbados	4	0	0	4	4	0	0	4
- Cayman Islands	0	1	0	1	0	0	0	0
- Cuba	2	0	0	2	2	0	0	2
- Fr. W. Indies	3	0	0	3	4	0	0	4
- Greenland	1	0	0	1	1	0	0	1
- Jamaica	8	1	0	9	8	1	0	9
- Japan	9	0	0	9	9	0	0	9
- Mexico	23	1	2	26	26	1	2	29
- Panama	5	0	0	5	5	0	1	6
- St. P. et Miq.	2	0	0	2	3	0	1	4
- Trinidad	5	0	0	5	5	0	0	5
- Uruguay	3	0	0	3	3	0	0	3
- USA (N.Y.)	0	3	2	5	0	3	2	5
- USA (S.F.)	0	2	0	2	0	2	0	2
TOTALS	78	9	5	92	87	9	8	104
Canber								
- Antigua	12	0	1	13	14	0	1	15
- Barbados	12	1	0	13	12	1	0	13
- Bermuda	29	2	3	34	38	2	4	44
- Trinidad	9	0	0	9	9	0	0	9
TOTALS	62	3	4	69	73	3	5	81
Cantat-1								
- India	1	0	0	1	1	0	0	1
- United Kingdom	25	0	4	29	25	0	4	29
TOTALS	26	0	4	30	26	0	4	30
Icecan								
- Greenland	1	0	0	1	1	0	0	1
- Iceland	5	1	0	6	5	1	1	7
TOTALS	6	1	0	7	6	1	1	8

TABLE 3A — CONT'D.

Country	1976 Tel	1976 Tg	1976 Leased	1976 Total	1978 Tel	1978 Tg	1978 Leased	1978 Total
Spade								
- Brazil	0	1	0	1	0	1	0	1
- Chile	6	0	1	7	8	0	1	9
- Colombia	0	0	0	0	0	1	0	1
- Peru	5	1	0	6	5	1	1	7
TOTALS	11	2	1	14	13	3	2	18
Tat-3								
- Germany	1	0	0	1	1	0	0	1
- United Kingdom	4	2	0	6	4	2	0	6
TOTALS	5	2	0	7	5	2	0	7
Tat-5								
- Italy (Mtl)	6	1	0	7	6	1	0	7
- Italy (Tor)	5	0	0	5	5	0	0	5
- Spain	3	0	0	3	3	0	0	3
TOTALS	14	1	0	15	14	1	0	15
Tat-6								
- United Kingdom	43	0	0	43	108	0	0	108
HF Radio								
- Greenland	1	0	0	1	1	0	0	1

TABLE 3B

Country	Estimated # of ckts required especially for Olympic broad-cast use	Possible alternative routes: First (Preferred)	Possible alternative routes: Second
Afghanistan	2	Cantat-2	
Albania	2	MV-2(Yugo)	
Algeria	2	Cantat-2	MV-1(PB)
Argentina	4	Terr (Andover)	
Australia	10	Lake Cowichan	Compac/SF
Austria	2	Cantat-2	MV-1(RA)
Bahamas	2	Terr (USA)	
Barbados	2	Canber	MV-1(Bar)
Belgium	4	MV-2(LI)	Cantat-2
Bermuda	2	Canber	
Bolivia	2	Terr (USA)	
Brazil	4	MV-1	
Bulgaria	2	MV-2(IV)	Cantat-2
Burma	2	Lake Cowichan	
Cambodia	2	Lake Cowichan	
Cameroons	2	Cantat-2	
Ceylon	2	Cantat-2	
Chad	2	Cantat-2	
Chile	2	Terr (Andover)	
Columbia	2	Terr (USA)	
Congo	2	Cantat-2	
Costa Rica	2	Terr (USA)	
Cuba	2	Terr (USA)	
Cyprus	2	Cantat-2	
Czechoslovakia	4	MV-1(RA)	MV-2(Yugo)
Dahomey	2	Cantat-2	
Denmark	4	Cantat-2	MV-1(GH)
Dominican Republic	2	Terr (USA)	
Egypt	2	Cantat-2	
Equador	2	Terr (USA)	
Ethiopia	2	Cantat-2	
Fiji	2	Lake Cowichan	
Finland	4	MV-2(Scand)	
France	12	MV-1(PB)	Cantat-2
Gabon	2	Cantat-2	
West Germany	14	MV-1(RA)	MV-2(RA)
East Germany	4	Cantat-2	
Ghana	2	Cantat-2	
Greece	4	MV-2	
Guadaloupe	2	MV-1(Barbados)	
Guatemala	2	Terr (USA)	
Guyana	2	MV-2 (Venezuela)	
Haiti	2	Terr (USA)	
Holland	6	MV-2(Nether.)	
Honduras	2	Terr (USA)	
Hong Kong	2	Lake Cowichan	
Hungary	4	MV-1(RA)	MV-2(Yugo)
Iceland	2	Icecan	
India	6	Cantat-2	
Indonesia	2	Lake Cowichan	
Iran	2	Cantat-2	
Ireland	4	Cantat-2	
Israel	4	MV-2	
Italy	10	Cantat-2	MV-1
Ivory Coast	2	Cantat-2	
Jamaica	2	MV-1	
Japan	8	Lake Cowichan	
Kenya	2	Cantat-2	MV-1(GH)
Netherlands Antilles	2	MV- 2(Venezuela)	MV-1(Trin)
North Korea	2	Lake Cowichan	
South Korea	2	Lake Cowichan	
Kuwait	2	Cantat-2	
Lebanon	2	MV-1(PB)	Cantat-2
Libya	2	MV-1(PB)	
Lichenstein	2	MV-2(Switzer.)	Cantat-2
Luxemburg	2	Cantat-2	
Madagascar	2	Cantat-2	MV-1(PB)
Malawi	2	MV-2(S. Africa)	
Malaysia	2	Lake Cowichan	
Mali	2	Cantat-2	
Malta	2	Cantat-2	
Monaco	2	MV-1(PB)	

TABLE 3B - CONT'D.

Country	Estimated # of ckts required especially for Olympic broadcast use	Possible alternative routes: First (Preferred)	Possible alternative routes: Second
Morocco	2	Cantat-2	MV-1(PB)
Mexico	6	Terr (USA)	
Mongolia	2	Lake Cowichan	
Nepal	2	Cantat-2	
New Zealand	4	Lake Cowichan	
Nicaragua	2	Terr (USA)	
Niger	2	Cantat-2	
Nigeria	2	Cantat-2	MV-1(GH)
Norway	4	MV-2(Scand)	
Pakistan	6	Cantat-2	
Panama	2	Terr (Etam)	MV-1
Peru	2	Terr (Andover)	
Philippines	2	Lake Cowichan	
Poland	2	MV-1(RA)	MV-2(Yugo)
Portugal	6	Cantat-2	MV-2
Puerto Rico	4	Terr (USA)	
Rhodesia	2	MV-2(S. Africa)	Cantat-2
Rumania	2	MV-1(RA)	MV-2(Yugo)
El Salvador	2	Terr (USA)	
San Marino	2	Cantat-2	
Saudi Arabia	2	Cantat-2	
Senegal	2	Cantat-2	MV-1(PB)
Sierra Leone	2	Cantat-2	
Singapore	2	Lake Cowichan	
Somalia	2	Cantat-2	
South Africa	2	MV-2(36/2.5)	
Spain	6	MV-1	MV-2
Sudan	2	Cantat-2	
Surinam	2	MV-2(Venezuela)	
Swaziland	2	MV-2(S. Africa)	
Sweden	4	MV-2(Scand)	
Switzerland	6	MV-2(Switzer.)	
Taiwan	2	Lake Cowichan	
Tanzania	2	MV-2(S. Africa)	
Thailand	2	Lake Cowichan	
Togo	2	Cantat-2	
Trinidad	2	MV-1(Trinidad)	
Tunisia	2	MV-1(PB)	Cantat-2
Turkey	4	Cantat-2	MV-2(TH)
Uganda	2	MV-2(S. Africa)	
United Arab Republic	4	Cantat-2	
United Kingdom	20	Cantat-2	MV-2(GH)
United States	**	Terrestrial	
Upper Volta	2	Cantat-2	
Uruguay	2	Terr (USA)	
USSR (Russia)	10	MV-1(GH)	
Venezuela	2	MV-2(192/10)	
Vietnam	2	Lake Cowichan	
Virgin Islands	2	Terr (USA)	
Yugoslavia	2	MV-2(Yugo)	
Zambia	2	Cantat-2	
	2		

** Ckts are carried by the domestic carriers.

then a 'reasonable' distribution of the total circuit requirements, and it was accepted as the basis.

From the equipment provisioner's point of view if the network could be designed to handle the circuit requirements as per Table 3B, with the addition of some spare capacity then there was no uncertainty of under-provision of equipment.

3.2 OLYMPIC CIRCUIT REQUIREMENTS

At this point we were able to determine the final edition of the Olympic circuit requirements. Table 3A and Table 3B were the basic information considered by Engineering in the process of study and evaluation of the gravity of the problem faced with.

The immediate problem facing the design engineer was to come up with an efficient and economical solution regarding the route of transmission for each country's circuits.

For that purpose, Table 3C was derived which indicates the answer with a specific further breakdown of the Olympic circuit by route of transmission.

Each total represents the additional number of special program circuits (2.7 KHz bandwidth) required on the different routes.

The distribution of the traffic of the Olympic broadcast quality circuits was:

TABLE 3C

BREAKDOWN OF OLYMPIC CIRCUITS BY ROUTE

Route	#
Lake Cowichan:	
- Australia	10
- Burma	2
- Cambodia	2
- Fiji	2
- Hong Kong	2
- Indonesia	2
- Japan	8
- North Korea	2
- South Korea	2
- Malaysia	2
- Mongolia	2
- New Zealand	4
- Philippines	2
- Singapore	2
- Taiwan	2
- Thailand	2
- Vietnam	2
TOTAL	50
Mill Village-1(Major)	
- Brazil	4
- France	12
- West Germany	14
- Guadaloupe	2
- Jamaica	2
- Lebanon	2
- Libya	2
- Monaco	2
- Spain	6
- Trinidad	2
- Tunisia	2
- USSR	10
- Czechoslovakia	4
- Hungary	4
- Poland	2
- Rumania	2
TOTAL	72
Mill Village-2(Primary)	
- Albania	2
- Belgium	4
- Bulgaria	2
- Finland	4
- Greece	4
- Guyana	2
- Holland	6
- Israel	4
- Lichenstein	2
- Malawi	2
- Netherlands Antilles	2
- Norway	4
- Rhodesia	2
- South Africa	2
- Surinam	2
- Swaziland	2
- Sweden	4
- Switzerland	6
- Tanzania	2
- Uganda	2
- Venezuela	2
- Yugoslavia	2
TOTAL	64
Canber	
- Barbados	2
- Bermuda	2
TOTAL	4
Icecan	
- Iceland	2

Route	#
Cantat-2	
- Afghanistan	2
- Algeria	2
- Austria	2
- Cameroons	2
- Ceylon	2
- Chad	2
- Congo	2
- Cyprus	2
- Dahomey	2
- Denmark	4
- Egypt	2
- Ethiopia	2
- Gabon	2
- East Germany	4
- Ghana	2
- India	6
- Iran	2
- Ireland	4
- Italy	10
- Ivory Coast	2
- Kenya	2
- Kuwait	2
- Luxemburg	2
- Madagascar	2
- Mali	2
- Malta	2
- Morocco	2
- Nepal	2
- Niger	2
- Nigeria	2
- Pakistan	6
- Portugal	6
- San Marino	2
- Saudi Arabia	2
- Senegal	2
- Sierra Leone	2
- Somalia	2
- Sudan	2
- Togo	2
- Turkey	4
- United Arab Republic	4
- United Kingdom	20
- Upper Volta	2
- Zambia	2
TOTAL	136
Terrestrial	
- Argentina	4
- Bahamas	2
- Bolivia	2
- Chile	2
- Colombia	2
- Costa Rica	2
- Cuba	2
- Dominican Republic	2
- Equador	2
- Guatamala	2
- Honduras	2
- Nicaragua	2
- Mexico	6
- Panama	2
- Peru	2
- Puerto Rico	4
- El Salvador	2
- Uruguay	2
- Virgin Islands	2
- Haiti	2
TOTAL	48

Route	% Distribution of the Olympic Circuits
MTL - BH (cantat-2)	36.17%
MTL - MV	19.15% (MV-1) 17.02% (MV-2)
MTL - VCR - LCN	13.30%
CANBER -	1.06%
ICECAN	0.53%
TERRESTRIAL	12.77%

3.3 EVALUATION OF EQUIPMENT/FACILITIES REQUIREMENTS

The next task for engineering was to evaluate the existing facilities and equipment on hand in order to establish the degree of equipment expansion required to safely meet the Olympic traffic needs.

By analyzing the normal requirements for April-76 and April-78, as given in the P1/74 planning report, and considering the established Olympic requiements as well as usual spare capacity we came up with a new set of data shown on Table 3D for the three gateway terminals of Montreal, Toronto, and Vancouver.

In Table 3D, we see that the derived total requirements for the Summer-1976 shown in column (B) and the derived total requirements for April-1978 shown in column (C), must be compared to the total equipment on hand shown in column (A).

The equipment requirements, therefore, should be either (B) - (A) = Δ or (C) - (A) = Δ. Considering the degree of uncertainty in the estimates as well as the importance of the responsibility of the

TABLE 3D - EQUIPMENT FACILITIES REQUIREMENT

Station	TYPE OF EQUIPMENT OR FACILITY		EQUIPMENT/FACILITIES REQUIREMENT										
			PRESENT										
	Type	Equip. or Facility	Super Groups	Groups	(A) Eqpt. On Hand June 1974	Normal Reqmts. Apr. 76 (P-1/74)	Special Olympic Reqmts. 1976	(B) Total Reqmts. Summer 1976	Normal Reqmts. Apr. 78 (P-1/74)	Spares & Misc.	(C) Total Reqmts. Apr. 78	Equipment Reqmts. (To be ordered) (Δ)
MONTREAL	Trans	3 KC Chan Bk			36	35	5	40	38	10	48	15
		4 KC Chan Bk			123	100	35	135	120	30	150	27
		GTE			37	28	8	36	33	10	43	6
		SGTE			8	6	0	6	6	2	8	0
		GRP EQLER			105	50	20	70	70	35	105	0
		TGF			11	6	5	11	4	7	11	0
		SG EQLER			56	12	8	20	17	10	27	0
		TSGF			6	2	1	3	2	4	6	0
		ECHO SUPP			933	520	220	740	700	210	910	0
		PROGRAMES			6	6 (est)	6	12	8 (est)	2	10	6
		AUDIO AMP.			320	220	100	320	240	80	320	0
		AUDIO ATTEN			400	220	100	320	240	160	400	0
		SF UNITS			80	50	20	70	45	35	80	0
		VF RINGERS			64	30	30	60	40	24	64	0
		AUD. DEL. EQ.			80	20	20	40	40	40	80	0
		ENG O/W				6						6

TABLE 3D (CONT'D) - EQUIPMENT FACILITIES REQUIREMENT

Station	Type of Equipment or Facility: Type	Type of Equipment or Facility: Equip. or Facility	Equipment/Facilities Requirement: Present: Super Groups	Present: Groups	(A) Eqpt. On Hand June 1974	Normal Reqmts. Apr. 76 (P-1/74)	Special Olympic Reqmts. 1976	(B) Total Reqmts. Summer 1976	Normal Reqmts. Apr. 78 (P-1/74)	Spares & Misc.	(C) Total Reqmts. Apr. 78	Equipment Reqmts. (To be ordered) (Δ)
TORONTO	Trans	3 KC Chan Bk			16	15	10	25	25	11	36	20
		4 KC Chan Bk			6	10	0	10	10	6	16	10
		CTE			6	5	2	7	7	5	12	6
		SGTE			2	2	0	2	2	1	3	1
		GRP EQLER			15	15	10	25	25	10	35	20
		TGF			10	0	0	0	0	10	10	0
		SG EQLER			5	3	2	5	5	2	7	2
		TSGF			8	0	0	0	0	8	8	0
		ECHO SUPP			300	305	100	405	435	135	570	270
		PROGRAMES			0	2	1	3	2	1	3	3
		AUDIO AMP.			50	20	0	20	30	20	50	50
		AUDIO ATTEN			0	0	0	0	0	100	100	100
		SF UNITS			36	0	0	0	0	36	36	0
		VF RINGERS			20	0	0	0	0	20	20	0
		AUD. DEL. EQ.			16	0	0	0	0	16	16	0
		ENG O/W			6	2	1	3	4	2	6	0

TABLE 3D (CONT'D) - EQUIPMENT FACILITIES REQUIREMENT

Station	TYPE OF EQUIPMENT OR FACILITY		EQUIPMENT/FACILITIES REQUIREMENT									
			PRESENT									
	Type	Equip. or Facility	Super Groups	Groups	(A) Eqpt. On Hand June 1974	Normal Reqmts. Apr. 76 (P-1/74)	Special Olympic Reqmts. 1976	(B) Total Reqmts. Summer 1976	Normal Reqmts. Apr. 78 (P-1/74)	Spares & Misc.	(C) Total Reqmts. Apr. 78	Equipment Reqmts. (To be ordered) (Δ)
VANCOUVER	Trans	3 KC Chan Bk			6	5	0	5	5	1	6	0
		4 KC Chan Bk			69	55	20	75	55	10	65	10
		GTE			20	12	4	16	12	5	17	0
		SGTE			4	2	0	2	2	2	4	0
		GRP EQLER			39	30	5	35	30	5	35	0
		TGF			13	5	5	10	5	5	10	0
		SG EQLER			0	4	4	8	6	2	8	8
		TSSF			20	5	2	7	5	2	7	0
		ECHO SUPP			180	162	44	208	200	20	220	1 rack 100
		PROGRAMES			4	4	2	6	4	2	6	2
		AUDIO AMP.			582	250	50	300	300	20	320	0
		AUDIO ATTEN			464	330	50	380	400	20	420	0
		SF UNITS			0		0					0
		VF RINGERS			34							0
		AUD. DEL. EQ.			85	20	10	30	40	10	50	0
		ENG O/W			4	3	0	3	3	1	4	0

corporation for the games, engineering had to make a decision which would minimize the risk of under-provision of facilities. Under the circumstances it was therefore decided to shift the provision of the facilities planned for April-1978 by two years ahead.

3.4 CHOICE OF LOCATION

The location of the ISPC was another issue which required careful consideration. Because of the fact that most of the activities were taking place in the Montreal area the nerve point would be the gateway terminal of Montreal. Considering the economics of the installations because of distance from the transmission equipment, because of the redesigning of the area chosen, as well as the environmental benefits of a separate room, it was decided to build the ISPC in a separate room. (Ref. Teleglobe Dwg. #B5/E/1.1/2).

The room chosen was surrounded by noise-proof walls isolated from any external noise, etc., with fire exit and situated about 300 feet of cabling distance from the MDF of the transmission equipment. The total area was approximately 1100 ft^2, that is 55' x 20'.

CHAPTER IV

DESIGN STAGES PROBLEMS AND SOLUTIONS

4.1 DESIGN CONSIDERATIONS

This chapter is dealing with the design stages of the International Sound Program Center (ISPC), the various problems encountered in the process and the solutions given to those problems from an engineering point of view.

Before we enter into the details, it is necessary to outline the design considerations, or in other words, the criteria and technical parameters governing the process of the development of the system. Such considerations are the system parameters, the space requirements, the manpower, and the economics involved.

4.1.1 System Parameters

In order to size up the overall system configuration we first had to identify the parameters involved.

The system would serve as an interface between the various sites of the games and approximately 120 different countries around the globe. It had to be designed in such a way, that a high degree of operational efficiency would be assured for the peak program transmission periods, at a minimum cost. From the operations point of view one operator would be required to handle an average of 10 to 12 programs simultaneously. It was therefore necessary to provide a system with ten operator positions. That is, ten consoles, each equipped with all the facilities and accessories that one operator requires to properly line-up, monitor and maintain the program transmission assigned to his routes. Due to the fact that not all of 120 country routes would be equally loaded at all times, the design ought to provide flexibility of rerouting programs from one console to another or from one operator to another. The best way to achieve that was to concentrate all ten consoles in a separate room and line them up side by side.

The system had to be equipped with a Trouble Report Point (TRP) which would consist of the necessary facilities to receive and handle all the possible technical fault reports when experiencing transmission difficulties. The two operators manning the TRP had to be in close touch with the ten operators of the ISPC, as well as their counterparts of the other entities involved in the Olympic network. To achieve this, the TRP facilities were concentrated in two consoles especially designed for this purpose and they were placed in the same room with the ten ISPC consoles, and in a convenient location.

It is evident that the two primary system parameters, outlined in this section, required the provision of a combination of secondary system parameters, which would make the system functional, such as:

Access to International and city telephone lines for normal communications.

Access to order wire lines (private-lines) between stations and other administrations, or points of the network, for fast or emergency communication.

Access to the semi-auto telephone circuits with the <u>supervisory control facilities</u>.

Access to a specially designed <u>test-tone distribution network</u> with the required frequencies and levels, for lineup purposes.

Provision for <u>video monitoring facilities</u> to enable operators to control audio following video signals for quality.

Provision of <u>interconsole communications</u> and <u>trunk lines</u> whereby coordination of efforts for workload on program distribution and routing could be consolidated.

Another important task was the provision of a <u>versatile circuit design</u>, which would assure the ultimate degree of accessibility of any program by any operator with the minimum effort possible.

The detailed design for each of the parameters described above will be elaborated in Section 4.2, which deals with the system design.

4.1.2 <u>Space Requirements</u>

Before the space requirements were established, it was necessary to examine and identify the system parameters. At first it might be thought that the more space available the better. In this case though, it is not true. The space provided had to be sufficient to set up the equipment to offer adequate operational space for the crew manning the ISPC and finally to meet the safety, health and operational standards required for program sound centers of this type and magnitude. Overprovision or under provision of space would create inefficiency, since coordinated team work was a must.

The real space requirements for the equipment necessary would be as follows:

consoles and other equipment	=	325 ft^2
seating space 12 operators and one supervisor	=	208 ft^2
free space for moveability	=	200 ft^2
additional access space to fire exit	=	200 ft^2
Total —	=	933 ft^2

The minimum space required for the ISPC room, therefore, would be approximately 933 square feet. Ideally, an independent area surrounded by solid walls (studio type) would be best.

One such area was the former TASI room which measures approximately 1,296 square feet, that is 72 ft long by 18 feet wide, at the north-west corner of the 2nd floor of the Montreal gateway terminal. This room is independent, surrounded by solid walls, and in the same floor as the ITMC/ISMC.

Another area considered was the south-west corner of the second floor, immediately next to the ITMC/ISMC. Although an important positive factor to build the ISPC close to the ITMC/ISMC for obvious advantages, it was ruled out because of the fact that the required environmental conditions and surroundings were not met. The noice and human interference therefore would outweigh the benefits.

Other areas away from the floor of the ITMC/ISMC were not considered, regardless of availability and other advantages. Consequently, the former TASI room was considered to be the ideal place for the ISPC, because of the short walking distance of its location from the ITMC/ISMC (less than 50 ft) and furthermore, the nature of its structure was providing the possibility through the necessary modifications to meet all the requirements which were stated earlier in this section, namely:

a) to erect a noise-proof solid wall to isolate the noise generated by the power station

b) to remove part of the TASI/IDF and modify the remaining portion with the required capacity to interface with the circuits between the MDF and the ISPC equipment

c) to build a raised floor about one foot above the concrete slab to facilitate cabling and equipment interconnections

d) to erect a partition wall at the west end of the room with an entrance door to the ISPC and two large sliding glass windows, in order to separate the ISPC room from the remaining working area.

e) use the remaining working area left between the ISPC and the ITMC/ISMC with further partioning to facilitate a Program Booking Center (PBC), and the required telex and teleprinter equipment for the games.

The modifications and alterations mentioned above will be outlined in a step-by-step procedure in the next chapter.

4.1.3 Manpower

The manpower requirements had to be planned with special considerations of the daily workload for the expansion due to the normal growth and the extra workload due to the Olympic installations.

The other important factor here was the time limit to meet the deadlines and have the system ready for service at least three months before the games for staff training, etc.

In order to achieve these goals a precise and careful breakdown of all the works and installation was done with emphasis in the major tasks involved. In the remaining of this section an attempt will be made to outline in short these major tasks and the estimated man hours in the sequence and order that they were planned and carried out.

4.1.3.1 MDF to IDF Cabling

The IDF was used as an intermediate distribution frame, to bring the point of interconnection close to the ISPC on one hand and to allow greater flexibility of crossconnections of different routes, on the other hand. The capacity therefore of the cables used between the MDF and IDF had to be greater than the total capacity of the system, in terms of pairs of wires. The total capacity of the system in terms of pairs of wires coming from ORTO was 225 triplets and 25 pairs of auxiliary or control lines, as shown in drawing No. BP5/D/4.3/1. That is, a total of 750 pairs of wires had to be the minimum cable capacity between the two points. Because of the existing degree of uncertainty for last minute additional requirements, and because of the low cost of the cable compared to the time and manpower requirements, to install new cable if needed, it was decided to increase the capacity of that link from 750 required pairs to 1020 pairs. Thus giving us a flexibility of beeing able to use 270 pairs of spare cable for unexpected circuits which might be required to handle in short notice.

The cable used, was the 60 pair 24 AWG of Northern Electric type 229A.

Man-Hours Required

MDF to IDF —— 17 runs x 200' = 3400 ft - total

IDF to MDF —— 17 runs x 225' = 3825 ft - total
34 runs 7225 ÷ 65 ft/M.H. = 112 M.H.
x 10 M.H. both ends
340 M.H.

For the interconnection of the cable therefore between MDF and IDF a total of 452 MH is required. That is, 112 M.H. for laying the cable since in 1 M.H. approximately 65 ft of cable can be laid, and 340 M.H. to connect 34 runs of cable both ends since it takes approximately 5 M.H. to connect one side of a 60 pair cable to an MDF or IDF block.

Thus:.

MDF to IDF cabling required 452 M.H. both ways.

4.1.3.2 IDF to Consoles Cabling

The manpower required in this part of the installation was calculated on a different basis. Each console will be connected to the IDF with 4 runs of 60 pair 24 AWG cable. Details of this wiring will be given in a later chapter which will be dealing with the installations instructions of this part.

IDF to Consoles

4	runs/console
x 20	M.H./console
80	M.H./console both ends
x 10	consoles
800	M.H. for all 10 consoles

For the interconnection of the 10 consoles with the IDF using 4 runs of 60 pair cable, a total of 800 M.H. was required using the 10 minutes per connection rule of thumb.

Thus:

IDF to consoles cabling required 800 M.H. both ends.

4.1.3.3 MDF and IDF Jumpers Required

MDF to IDF	17 cables	x	5 M.H.	=	85 M.H.	
IDF to MDF	17 cables	x	5 M.H.	=	85 M.H.	
IDF to Consoles	20 cables	x	5 M.H.	=	100 M.H.	
Consoles to IDF	20 cables	x	5 M.H.	=	100 M.H.	
Total jumpers require				=	370 M.H.	total

Thus:

Total Man Hours required for jumpers; 370 M.H.

4.1.3.4 Other Wiring and Installations

The remaining wiring and installations works will be shown in this section, in general and without detailed analysis of each item.

a) supervisory control wiring:	172 M.H.
b) interconsole wiring:	105 M.H.
c) international telephone lines Erricsson sets wiring:	140 M.H.
d) intercommunication lines:	70 M.H.
e) hardware installations:	140 M.H.
f) power connections and installations:	70 M.H.
g) corrections and tests:	105 M.H.
TOTAL:-	802 M.H.

4.1.3.5 Total Manpower Requirements Summary

MDF & IDF cabling:	452 M.H.
IDF & consoles cabling:	800 M.H.
Jumper wiring:	370 M.H.
Other wiring & installations:	802 M.H.
Engineering, 20 man months: (which includes supervision of installation & tests)	3,200 M.H.

4.1.3.6 Work Schedule

- The total man-hours for the field work required was 2,424 M.H. It is evident that by applying the 35 M.H. per week, it was necessary to provide one man for seventy weeks or approximately 18 months, in order to complete the project.

- In doing the work schedule the following facts had to be considered. The project could not start before September 1975, because of certain other commitments and renovations which had to be carried out first. The system had to be complete and ready for service by May, 1976.

The availability of skilled personnel to assign to this project.

- The fact that the raised floor and other civil works of the ISPC room were contracted to finish by September 30, 1975.

With these facts in mind as well as the possibilities of sick days, holidays, and other absences, the project was scheduled to start on October 1, 1975, with a coordinated effort of a minimum of four men and a maximum of six men working simultaneously, in order to be completed by no later than February 1976. March and April could, therefore, be used for final modifications and tests. May and June were reserved for training of the operators and other personnel on the system. See bar chart for work schedule below.

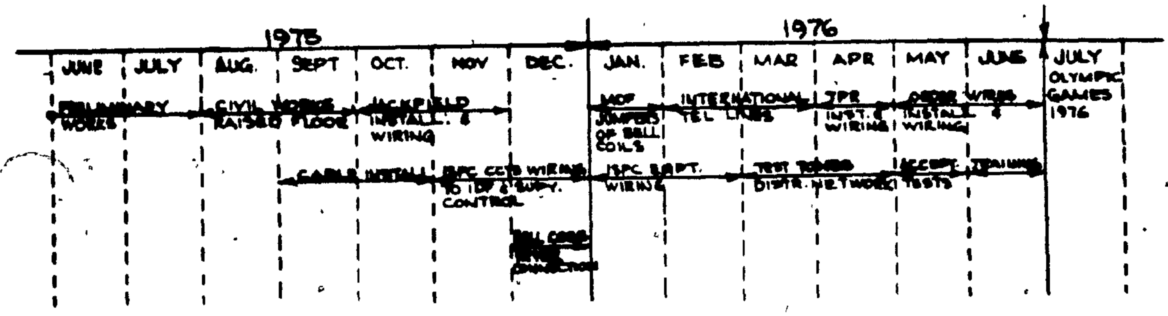


Fig. 4.1 — Bar Chart for Work Schedule.

4.1.4 Budgetary Considerations

Another important governing factor of this project was the budgetary consideration by the circumstances surrounding it.

The budget was covering all the expenses required for the equipment expansion due to the Olympics as well as the equipment expansion attributable to the normal growth. Table 4.1 shows the amount committed in the first column, the Olympic cost in the second column, the costs attributable to the normal growth in the third column. The fourth column shows the equipment recovery value where applicable, and the fifth column shows the net cost due to the Olympics.

STATION	EQUIPMENT	QTY	74 AMOUNT COMMITTED	75 AMOUNT COMMITTED	OLYMPIC COSTS	COSTS ATTRIBUTABLE TO NORMAL GROWTH	EQPT RECOVERY VALUE	NET COSTS DUE TO OLYMPICS	NOTES
Montreal ISPC	Rental of Audio Cable Pairs	725	93000.		93000.			93000.	Program (rental)
and Olympic	Program Translation Eqpt.	8	80000.		80000.			80000.	"
Program	Console Frames	11		15000.	11000.	4000.		11000.	"
Booking Ctr.	VU Meters	10		5000.	4000.	1000.	1000.	3000.	"
(includes FRP)	Monitor Spkrs & Splitting Amps	10		4500.	4000.	500.	1000.	3000.	"
	HP 3550B Audio Test Sets	2		4000.	2000.	2000.	2000.		Transmission Eqpt.
	Supervisory Control Eqpt.			2000.	2000.			2000.	Program
	Audio Patch Facilities			18000.	16000.	2000.		16000.	"
	2W/4W Hybrids	15		1200.	1000.	200.	500.	500.	"
	Digital Clocks	6		1500.	1000.	500.	1000.		"
	Earphones	12		600.	500.	100.		500.	"
	Line Connecting Eqpt. (14 MIB's)			30000.	18000.	12000.		18000.	"
	Order Wire Eqpt.	6		36000.	24000.	12000.	12000.	12000.	"
	Miscellaneous Test Eqpt.			25000.	20000.	5000.	10000.	10000.	"
	MIB HF Injection Eqpt.			5000.	4000.	1000.		4000.	"
	Attenuators			15000.	15000.		5000.	10000.	"
	Cabling			25000.	20000.	5000.	200.	19800.	"
	Racking			2000.	2000.		1000.	1000.	"
	Lighting and Power			10000.	8000.	2000.	1000.	7000.	"
	Building Changes & Furniture			30000.	28000.	2000.	2000.	26000.	"
	Assembly & Installation Effort			70000.	50000.	20000.		50000.	"
	Engineering Effort			40000.	30000.	10000.		30000.	"
	TOTALS		$173000.	$339800.	$433500.	$79300.	$36700.	$396800.	

TABLE 4.1 — Montreal ISPC and Olympic Program Booking Center Cost Analysis.

4.2 SYSTEM DESIGN

4.2.1 The Floor Layout and the Raised Floor

In the design process of the ISPC special consideration was given into the choice of features and facilities of the room itself as well as into the shape and form of the floor layout, in order to assure efficient operation.

The system consisting of twenty bays side by side from one end of the ISPC room to the other along with other consoles and equipment, as shown in Fig. 4.2, required an enormous number of wiring and cabling for connections and interconnections. The main problem faced with, was how to facilitate cabling between consoles, as well as between consoles and the IDF.

A single line diagram in Fig. 4.3 shows the approximate rooting of the multiple and numerous cable runs between the IDF and the consoles.

There were various ways that we could face the problem but because of the long term planning considerations the choice was limited between an overhead cabling routing and an underground cabling routing. The second choice was also requiring a raised floor (false floor) in order to make it possible.

After careful studies, cost comparisons and the necessary engineering considerations the decision was made to provide a raised floor 12" high in order to facilitate the cabling underground. It was also decided that the raised floor would be constructed by an outside contractor through the normal process of a call for tenders, and to the following specifications:

SPECIFICATIONS

1. Construct 6" concrete block partition approximately 19'-0" long by 14'-0" high, plastered and painted both sides including 4" black rubber cove base, one hollow metal man door and frame complete with Glass Lite and hardware.

2. Supply and install infinite access floor over an area of approximately 54'-6" x 19'-0" complete with step and ramp at door openings, twelve (12) floor grilles over heating convertors, floor framing for equipment opening approx. 7'-6" x 2'-4".

3. Chip down one stair riser below new floor level and remove part of dwarf partition for new ramp.

4. Remove push bar from existing exit door, supply and install new security type hardware to match existing.

5. Patch existing acoustic tile ceiling, - an area of 100 sq. ft. allowed for.

6. Remove railing at existing dwarf wall.

7. Supply and install Mov-A-Wall type partition to ceiling at existing dwarf partition, complete with five (5) openings for cable trays, etc., re-install existing door, frame and hardware, install new glass lite and door closer in door.

8. Remove and relocate existing bulletin board and shelf.

9. Supply and install approx. 35'-6" by 8'-0" high Mov-A-Wall type partitioning, complete with one (1) door, frame and hardware.

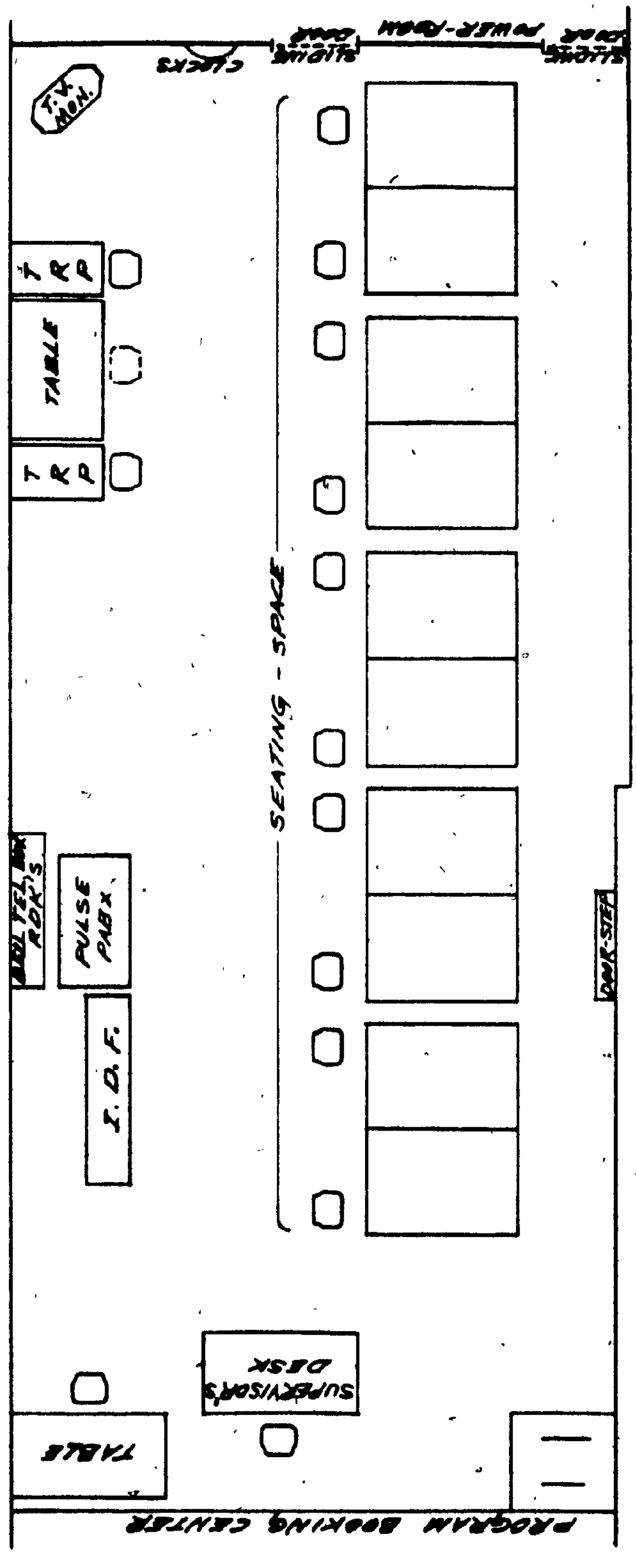


Fig. 4.2 - ISPC Floor Layout (sheet 1 of 2)

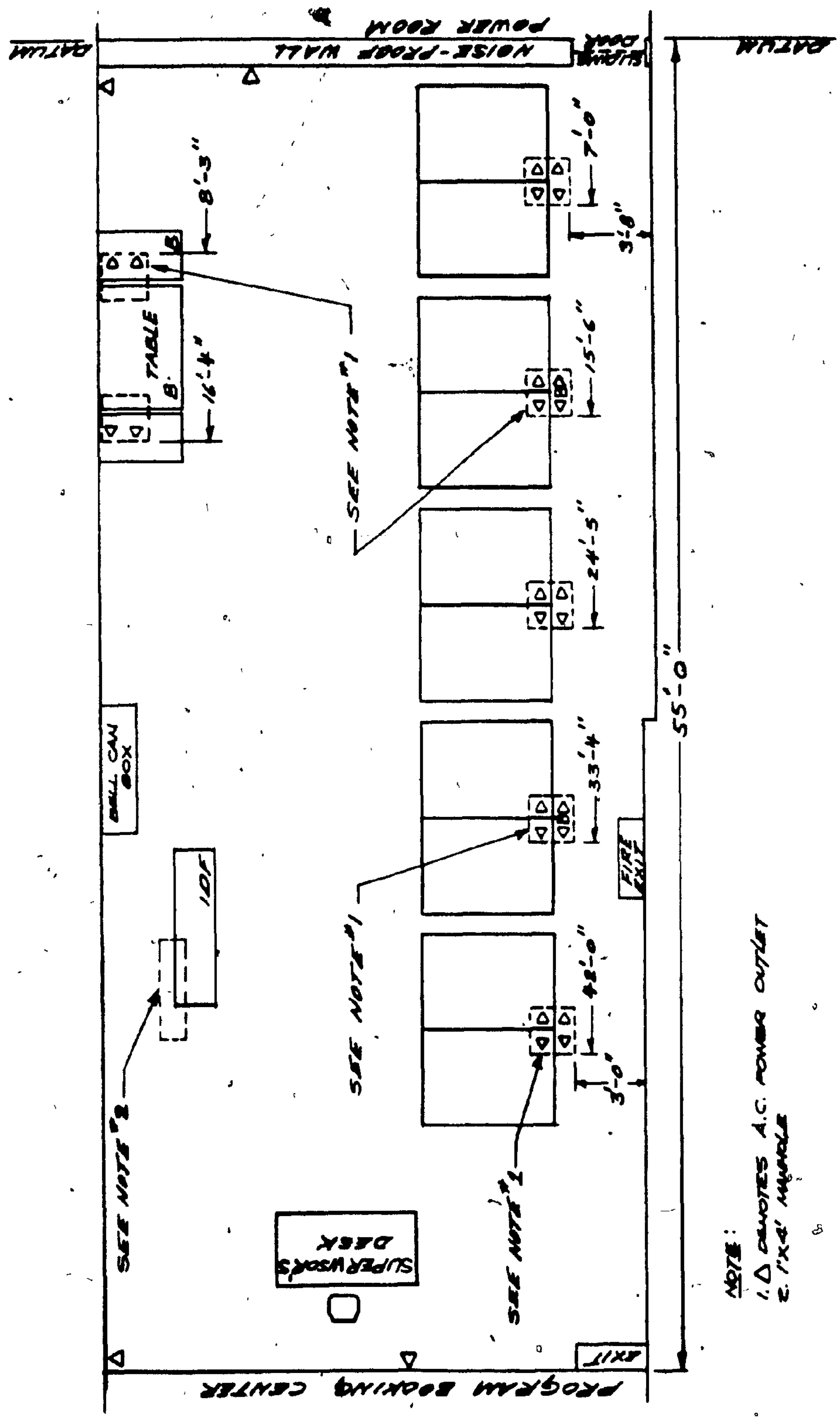


Fig. 4.2 - ISPC Floor Layout (sheet 2 of 2)

10. Paint walls, doors, etc., in alteration area, (except where ~~35'-6" of~~ new partitioning installed).

11. Electrical work —

    a) supply and install thirty-nine (39) new electrical fixtures.

    b) remove four (4) existing fixtures.

    c) raise five (5) existing wall plugs 12" above new floor level.

    d) remove one (1) surface mounted wall plug.

12. All necessary supervision, clean-up, etc., included.

The raised floor and other civil works in the area were completed as specified at approximately $26,000.00 of cost.

4.2.2 The Consoles

The consoles, like all the equipment required for the project had to be either purchased if possible off-the-shelf or manufactured to our specifications. Although there was a variety of consoles available from different suppliers, the nature of the project was somehow special and therefore it was difficult to satisfy all our needs with commercially available items. For that reason, it was decided to combine existing console models with our requirements and come up with a new model which would satisfy our special application.

The design of the model of consoles started by defining first the requirements which can be described as follows:

a) Jackfield panel requirements to meet the predetermined capacity of the system (type of jackfields and quantity)

b) Test equipment requirements for the operation of the system (type, quantity and size).

c) Test trunk and other auxiliary panel requirements (quantity and size).

d) Spare space for unforseen requirements.

e) Human engineering and operational requirements.

In order to cover the jackfield requirements described in part (a) and part (c) it was necessary to provide mounting space on each console for nine jack panels of 5 1/4 inches each for a total of 576 jacks. That is a total of 47 1/4" of mounting space per console, as shown in Fig. 4.4 and Fig. 4.5.

To cover the test equipment requirements described in part (c) and part (d) such as:

10 x 1	VU meter	5 1/4" space
10 x 1	Monitor amplifier	1 3/4" shelf space
10 x 1	Hybrid	
10 x 1	Distribution network	
10 x 1	Distribution network	
* 1 x 1	HP 3550 Test Set	7" space
* 1 x 1	Adjustable attenuators	1 3/4" space
3 x 1	Speaker panel	8 3/4"
* 1 x 1	Speaker, portable-box;	no mounting space req'd.;

it was necessary to provide mounting space on each console for the combination of these panels, of a total of 15 3/4".

Note: Items with asterisk (*) were required for the main console only.

All ten consoles were uniform and identical except in the case of the main console, where instead of the 8 3/4 inch speaker panel the HP 3550 test set and the adjustable attenuator pads panel were mounted. The speaker therefore was chosen to be a portable-box from McCurdy and it was appropriately mounted on the top of the console.

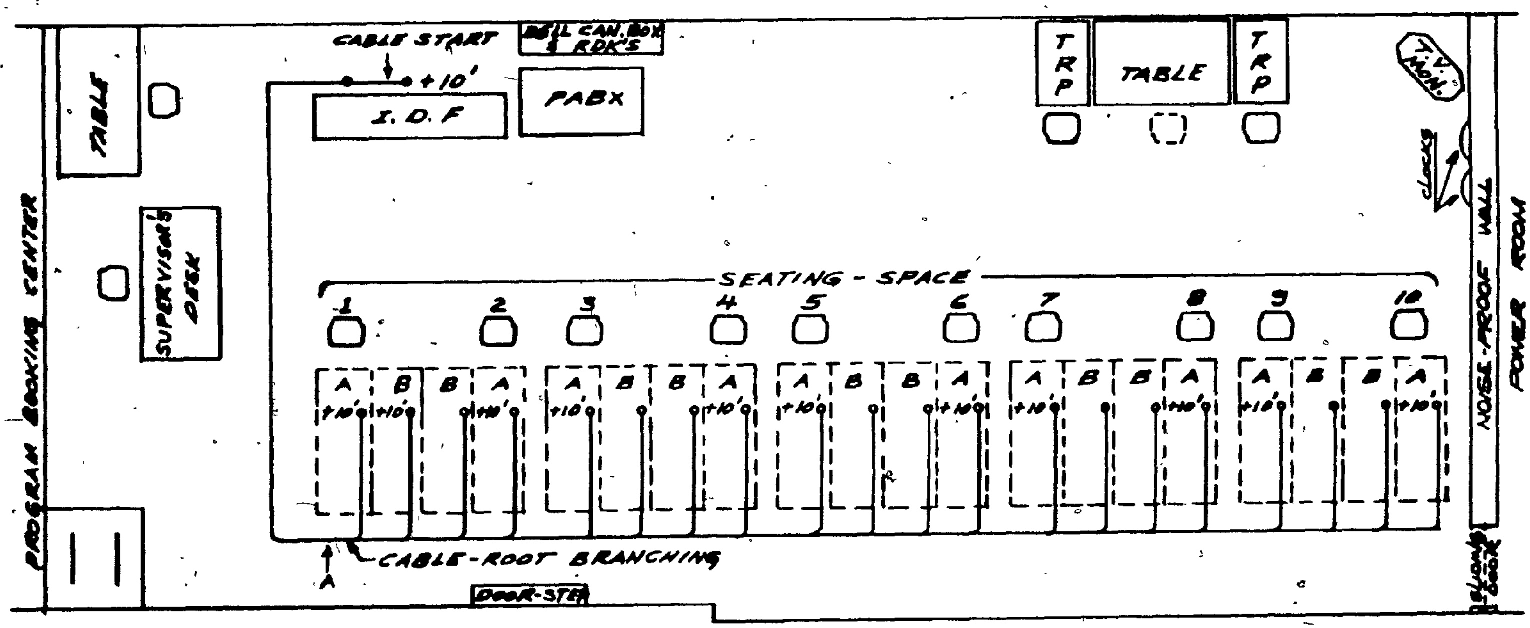


Fig. 4.3 - ISPC Consoles and Cabling Layout

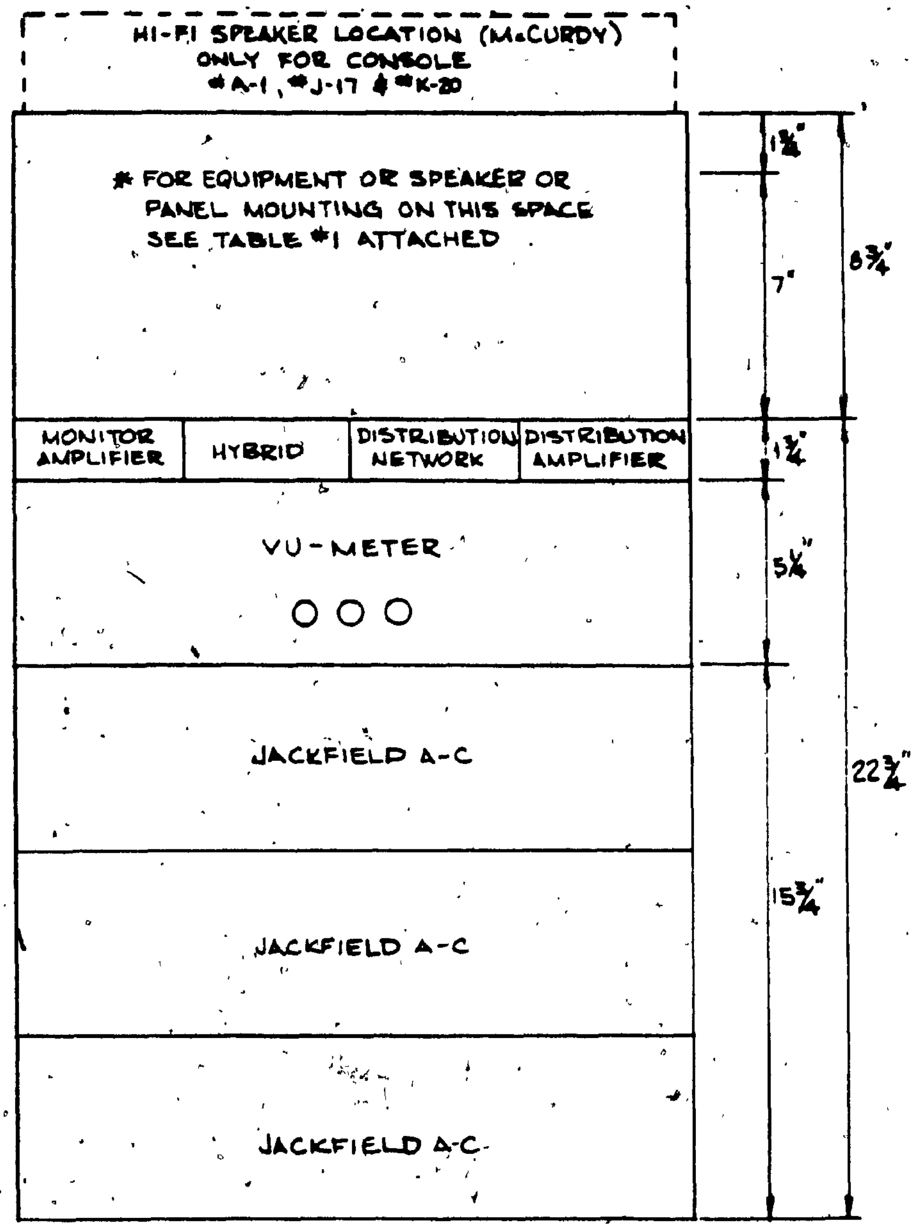


Fig. 4.4 - Console Equipment Assembly (Bay A)

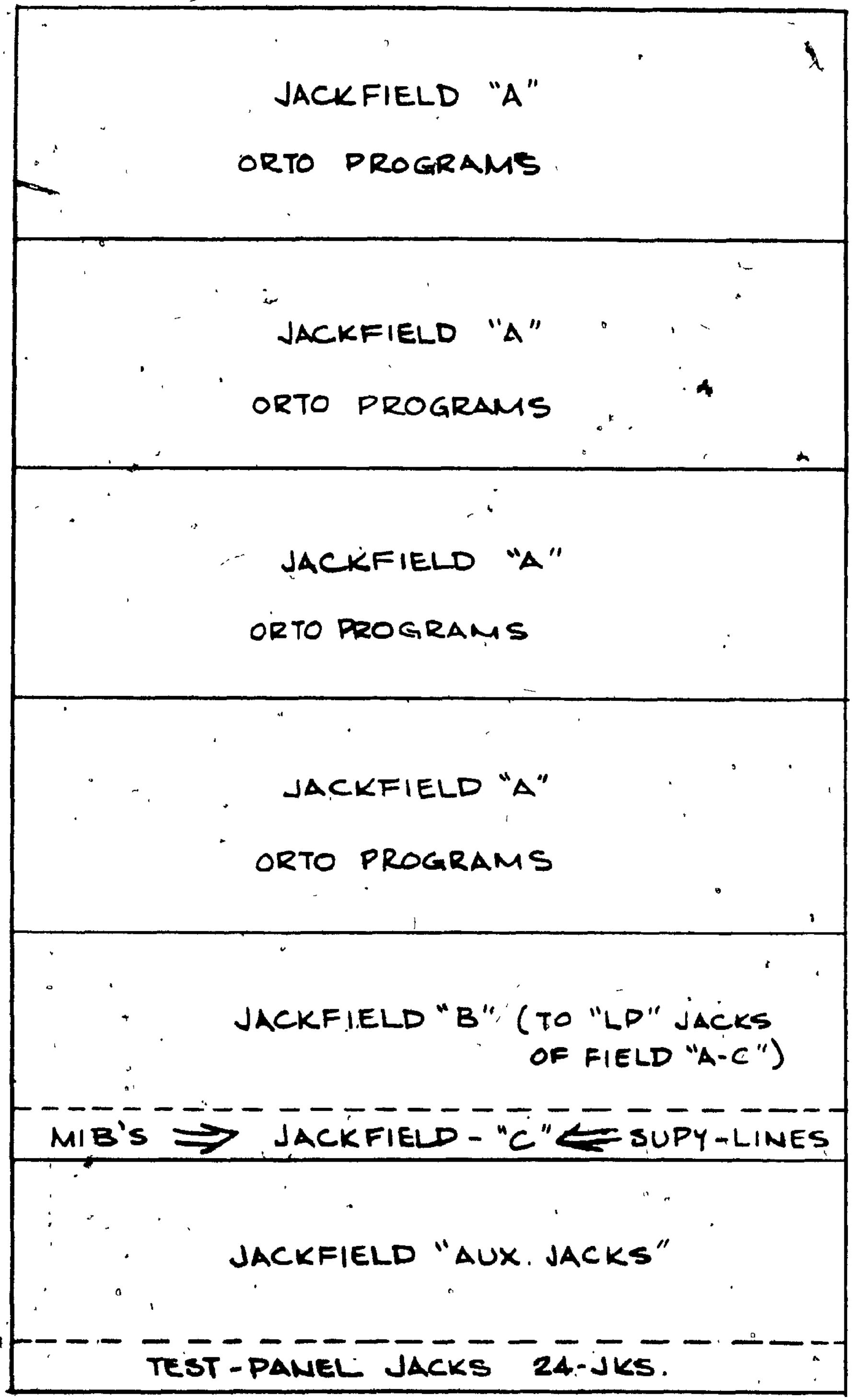


Fig. 4.5 — Console Equipment Assembly (Bay B).

Details of the content of the panel of that part of each console is shown in Table 4.2.

All the space requirements discussed so far, had to be combined together with the operational and human engineering requirements and come up with a version of console which consists of 2 bays side by side, as shown in Drawing No. BP43/D/1.3/1.

The main features of this model of console were:

a) Adequate comfort for the operator of the console

b) Sufficient mounting space for all the equipment and jackfields

c) Flexibility of set up and layout of the system.

The specifications given to the manufacturer are those shown in the Teleglobe drawing No. BP43/D/1.3/1 and the cost per console was approximately $1200 dollars.

4.2.3 Circuit Arrangements

The design of the circuits was a very critical factor to the success or failure of achieving the ultimate degree of efficiency and operational accessibility of programs, by any ISPC operator at any given time.

The answer to that problem is illustrated in Fig. 4.6 and Fig. 4.7.

In the first phase a single line diagram of Fig. 4.6 shows two groups of multiple loops independent of each other. One group of multiple loops appears on alternate consoles 1, 3, 5, 7 and 9, carrying 50% of the ORTO lines and programs. The other group of multiple loops appears on alternate consoles #2, 4, 6, 8, and 10, carrying the remaining 50% of the ORTO lines and programs. This way, we managed to terminate all of the ORTO programs and lines in the form of multiple loop appearances, from the IDF

CONSOLE & BAY No.	HI-FI SPKR	PADS	HP-3550 TEST-SET	PANELS 8 3/4" Blank Panel	8 3/4" SPKR Panel	7" SPKR Panel
1A	✓			✓		
2A					✓	
3A		✓				✓
4A					✓	
5A					✓	
6A					✓	
7A					✓	
8A					✓	
9A	✓	✓	✓			
10A	✓			✓		

Notes: 1. Where HI-FI speaker is indicated, to be mounted on top of cabinet and extend wiring to reach it. - i.e. for console #1A, 9A, and 10A.

2. Where 7" SPKR panel is indicated, to be mounted at the top of the available space of the console.
Between this speaker panel and the other equipment (HYBRID, etc.) install the 1 3/4" frame containing the attenuator pads.
i.e. for console #3A.

3. For console #9A install frame of attenuator pads above the HP-3550 Unit.

TABLE 4.2 — Speaker and Panel Mounting.

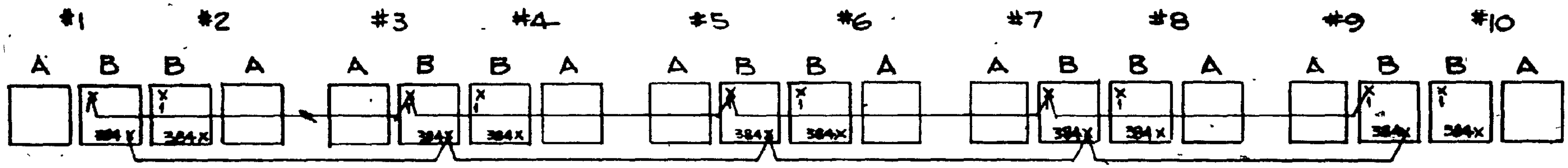


FIG. 1

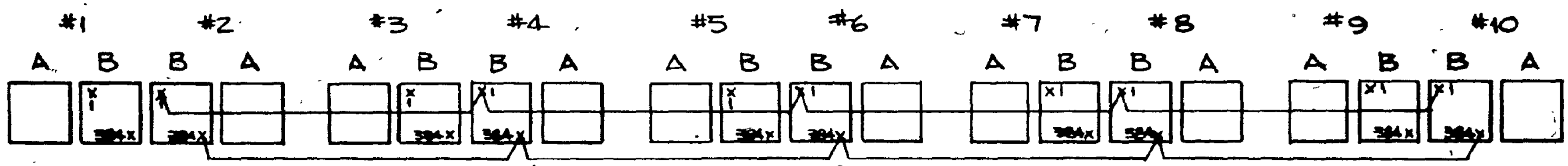
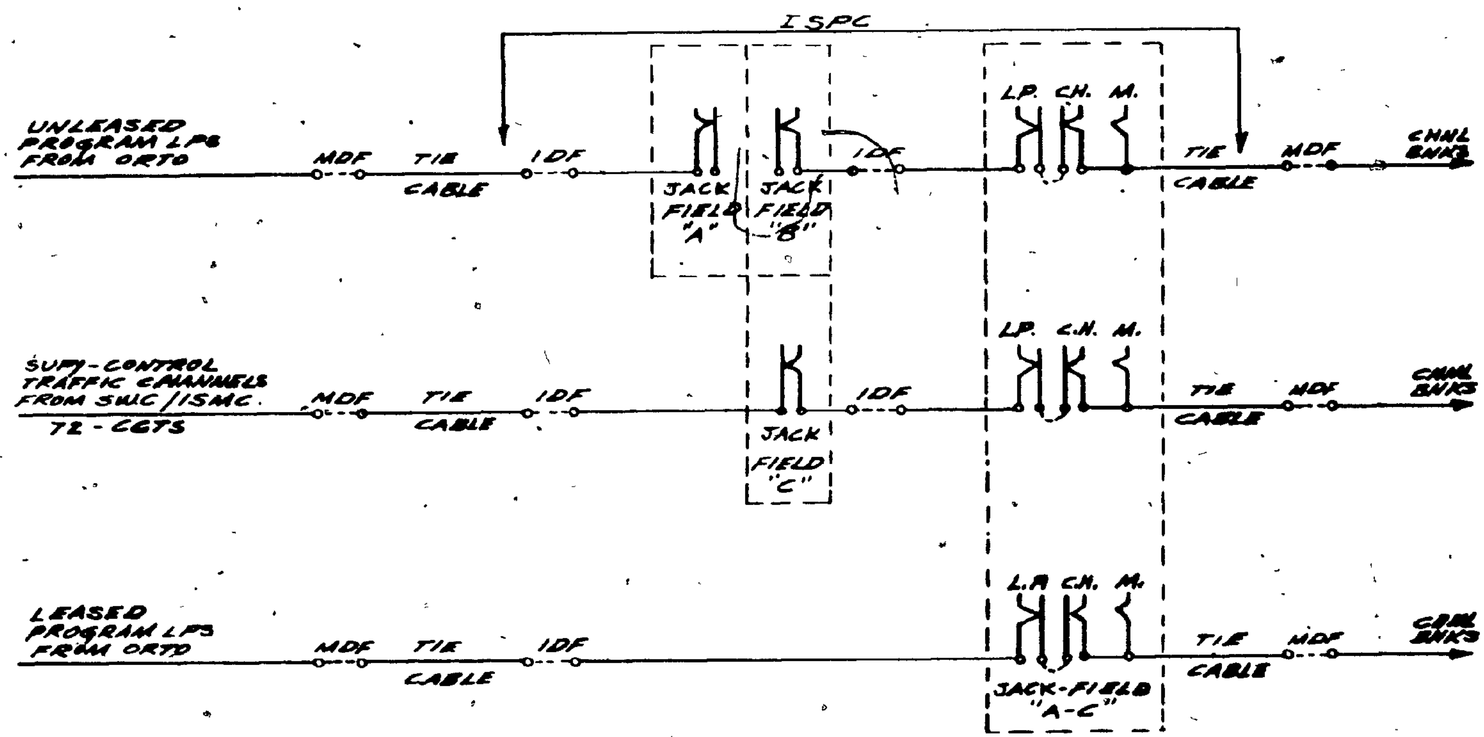


FIG. 2

Fig. 4.6 — Single Line Diagram, Jackfield "A" Parallel Combination.

<u>Notes:</u>

1. This sketch shows the principle of wiring the jacks of Jackfield "A" in parallel combination, indicating the No. 1 Jack and No. 384 Jack of the Jackfield of each console for clarity only.
2. Detail 1 shows one parallel network and the bays concerned.
3. Detail 2 shows the second parallel network and the bays concerned.
4. The two parallel networks are independent of each other.
5. Above single line diagram implies wiring of tip and ring of each jack.



Note: Between Jackfield "A" and Jackfield "B" or "C", patch cord is to be used in order to connect any undesignated ORTO CCT to any channel bank.

Fig. 4.7 - Jackfields and Circuits, Single Line Diagram.

to all ten consoles. These appearances with an appropriate jackfield combination, which will be discussed in the next section, enabled each and every operator of any console to access any ORTO program at any given time. The point of termination of these multiple appearances, was the jacks of jackfield "A" as shown at the detail of Fig. 4.6, and they were used for the UNLEASED circuits only. The maximum capacity of this jackfield was 768 programs or lines, which was over and above the 725 lines capacity of the ORTO facilities.

The second phase of circuit arrangements relates to the type of circuit illustrated in Fig. 4.7 under the heading jackfield "A-C" and it is enclosed in a dotted line system.

This type of circuit originates at the IDF and it goes to the tip of the loop jack (LP). From the ring contact of the same jack it is internally jumpered to the ring contact of the channel jack (CH). From the tip contact of the channel jack the circuit is connected directly to the tie cable going to the MDF and thereafter to the channel banks. A monitor jack (M), is also connected in parallel with the channel jack and from the side of the MDF as shown in Fig. 4.7. The same figure also illustrates that any program or type of line ought to go through jackfield "A-C" regardless of its origin. As seen, the only difference was at the way that each type of circuit was reaching that point. Namely the LEASED program loops were connected directly at the IDF to the "LP" jack of jackfield "A-C". The UNLEASED program loops had to go from the IDF to the termination point at jackfield "A". From there via a patch cord the program was patched to jackfield "B", which in turn was returned back to the IDF and thereafter through a jumper connected to the "LP" jack of jackfield "A-C" for transmission. In the same way, an unleased circuit could be patched to jackfield "C" if necessary by interrupting a traffic channel first with the busy-out switch of the supervisory control. The 72 traffic channel circuits were routed through the ISPC as an extra reserve of channels for the unleased circuits. More details of these type of circuits will be given in Section 4.2.8.

The ORTO programs and lines mentioned earlier in this section were sent to the ISPC of Teleglobe via Bell Canada facilities, and they were terminated at the MDF of our Montreal gateway terminal. The total number of circuits coming from ORTO in the form of triplets were: (ref. Dwg. #BP5/D/4:3/1)

a) 225 pairs of 5 KHz line, send

b) 250 pairs of 2.7 KHz line, send

c) 250 pairs of 2.7 KHz line, receive

In other words there were 225 wide band transmission paths (Tx) for quality programs 5 KHz each, and 250 narrow band two way lines transmit and receive. The 5 KHz program path could be used for transmission only, if quality programs without any talk back line, or it could be used with the other two narrow band (2.7 KHz) pairs (Tx) and (Rx) for talk back or commentary. In the latter case a full triplet would be used, that is:

one 5 KHz (Tx) program line (send)

one 2.7 KHz (Tx) commentary line (send)

one 2.7 KHz (Rx) commentary line (receive)

The type of circuit or the combination of circuits used, was depending on and governed by the particular requirements of the overseas subscriber. The ISPC consoles were also provided with a program distribution network.

The distribution network was made of one audio amplifier BAYLY type PDA-8 and one distribution network BAYLY type 4897. The BAYLY schematic diagram of the distribution network, Dwg. No. A-4897-4 is shown on pg. as Fig. 4.8, for reference. The output of the distribution amplifier was connected to P1-1 and P1-2 of the input transformer T1. Eight outputs were provided at the output plug P1, wired to the test panel of each console as follows:

Output No.		Jack			
	1	#71	Tip Ring	To	P1 - 10 P1 - 14
	2	#70	Tip Ring	To	P1 - 9 P1 - 13
	3	#69	Tip Ring	To	P1 - 8 P1 - 16
	4	#68	Tip Ring	To	P1 - 7 P1 - 17
	5	#67	Tip Ring	To	P1 - 6 P1 - 18
	6	#66	Tip Ring	To	P1 - 5 P1 - 20
	7	#65	Tip Ring	To	P1 - 4 P1 - 12
	8	#64	Tip Ring	To	P1 - 3 P1 - 11

The wiring of these jacks is shown in Fig. 4.12. In Fig. 4.8 it may be observed that each output is terminated across or 600 ohms resistor, considering the links A, B, C, D, E, F, G, and H from terminal point #1 to terminal point #2. For every output used the corresponding link has to be removed. In this application though it would be a cumbersome operation to remove a link for each output every time the distribution network was needed. For that reason the network was modified as follows:

a) all the links were removed

b) terminal point #2 of each link was wired to the tip-normal contact of the respective jack, via terminal board TB1.

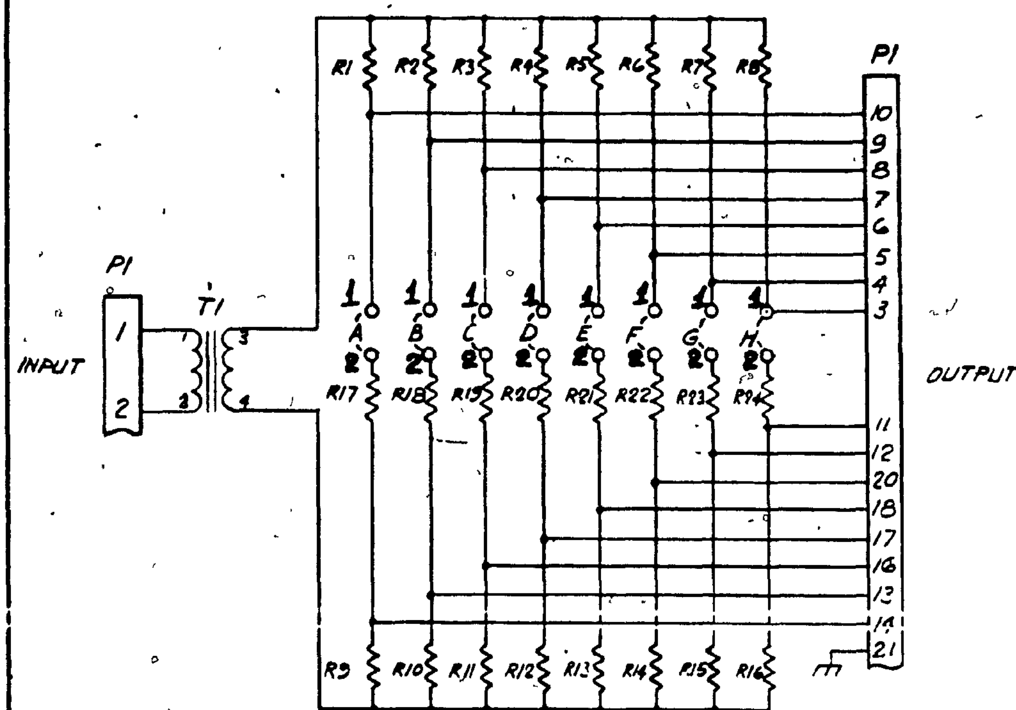


TABLE 2

LIST	P/N T1	INPUT Z
1	4897-10	5 Ω
2	4897-11	600 Ω

TABLE 1

OUTPUT NO.	CONNECT P1 PIN NO. S	REMOVE LINK
1	10 & 14	A.
2	9 & 13	B
3	8 & 16	C
4	7 & 17	D
5	6 & 18	E
6	5 & 20	F
7	4 & 12	G
8	3 & 11	H

1. R1 THRU R16 280 OHMS 1% 1W.
R17 THRU R24 600 OHMS 1% ½ W.

NOTES: UNLESS OTHERWISE SPECIFIED.

SYMBOL	REVISIONS	DATE	BY
3	R1-R16 WAS 300 Ω	15.10.71	HB
2	ADD TABLE 2	22/4/64	

SCALE — REMOVE ALL BURRS MAX 0.010

MATERIAL —

FINISH —

TITLE SCHEMATIC DIAGRAM TYPE 4897 DISTRIBUTION NETWORK

BAYLY ENGINEERING LTD. AJAX, ONT. CANADA.

TOLERANCE UNLESS OTHERWISE SPECIFIED FRACTIONS — DECIMALS — ANGLES

DATE	DRAWN BY	APPD BY
11 Mar/69	A.G.	

DWG. NO. A-4897-4

Fig. 4.8 — Bayly Program Distribution Network.

With the modification the links were present via the short of the normally closed contact at the tip of the jack, but the link was automatically removed each time an output of the network was used.

4.2.4 Types of Jackfields

The ten consoles were placed side by side along the ISPC room as illustrated in the ISPC Floor Layout, Fig. 4.2.

Each console was made of two individual bays attached together by bolts, as seen in Section 4.2.2.

For reference we had numbered the consoles from #1 to #10 and each console as having bay "A" and bay "B". The seating position of the operator was at bay "A", whereby he could comfortably access all of the area of bay "B". On bay "B" a drawer was mounted for the files and accessories of the operator.

The jackfields were carefully and selectively set-up in such a way as to provide maximum operational efficiency.

Jackfield "A-C" was mounted on the lower front part of bay "A" of each console, for reference see Fig. 4.9, and it was made of four panels.

Each panel had four horizontal rows of 24 jacks for a total of 96 jacks.

On the three panels we had a total of 12 rows of jacks. Starting from the higher panel, we labelled the first row as the monitor jacks (M), the second row as the channel jacks (CH) and the third row as the loop jacks (LP). Then the fourth row again monitor jacks (M), the fifth row (CH) jacks, the sixth row (LP) jacks, etc., all the way down to the 12th row which is a (LP) jack row.

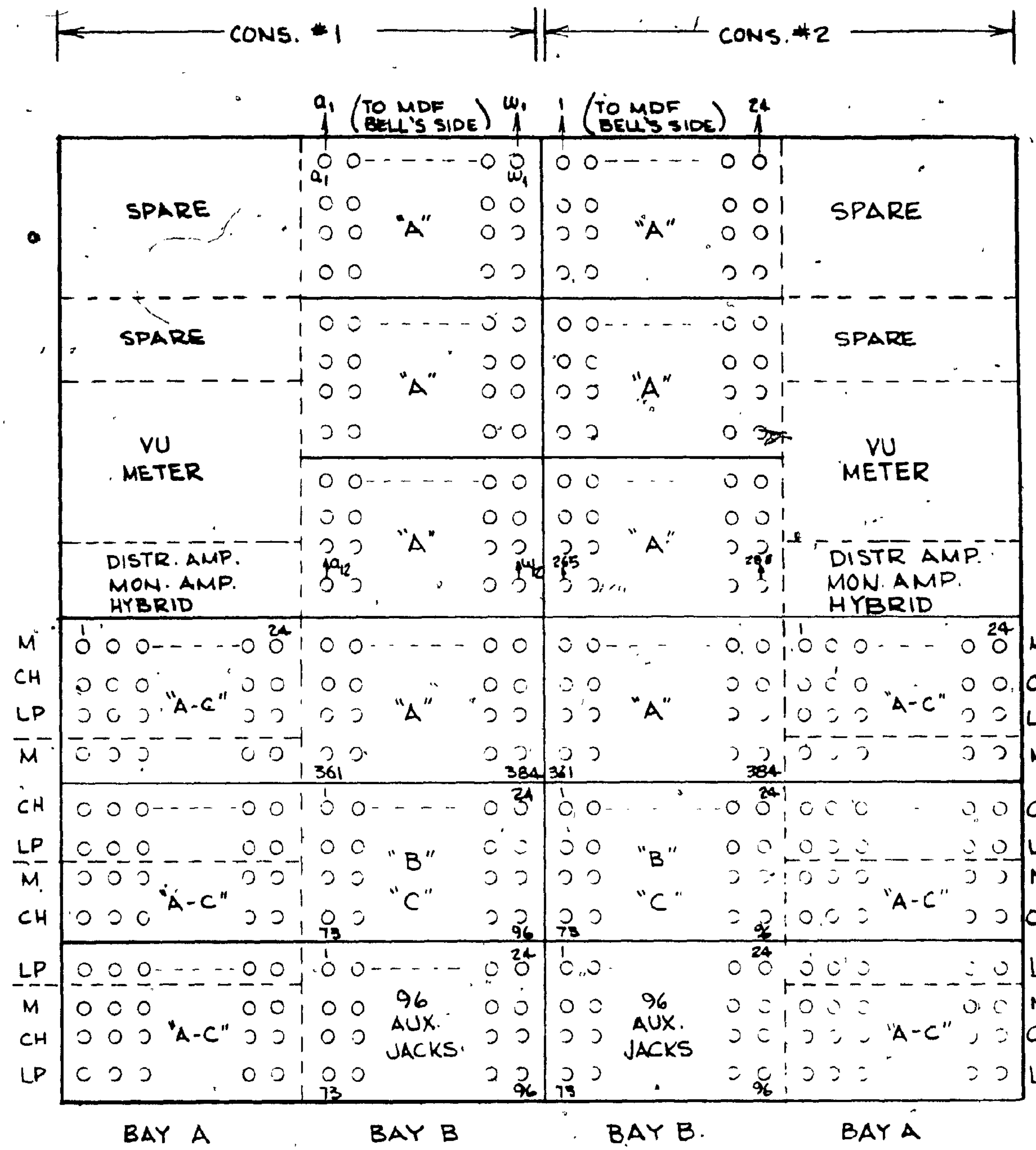
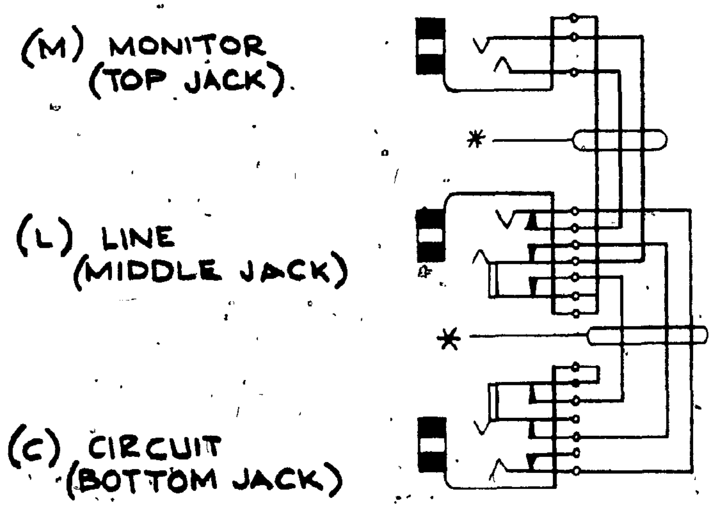


Fig. 4.9 — Console Equipment and Jackfield Layout.

The monitor jacks are simple tip and ring jacks without spring contacts. The channel jacks are identical to the loop jacks with tip, ring and sleeve as well as their spring contacts as shown in Fig. 4.10.



*Factory straps or welded connections, applicable to Patch Panels only.

Fig. 4.10 — Jack Assembly and Strapping.

Vertically, jackfield "A-C" consists of 24 columns; from 1 to 24. By the industrial standards the odd numbered column is the transmit (Tx) part of the channel and the even numbered column is the receive (Rx) part of the channel. In the present case though this could not be followed because of the TRIPLETS arrangement. In most cases it was necessary to use only one transmission path of 5 KHz or one 5 KHz and one 2.7 KHz for commentary, etc. That is, in most of the cases, it would require to have one receive path of the channel idle or not even connected to the ISPC at all.

To avoid potential confusion of the operators as well as to serve jackfield space, wiring and labelling of jackfields was made to accomodate all the ORTO circuits in triplet form rather than the standard industrial form. This was achieved in the following way.

Bay "B" of each console was used strictly for jackfields, as seen in Fig. 4.9. The top four panels were used to terminate all the triplets from ORTO clearly numbered and identified. As explained in Section 4.2.3, jackfield "A" of each console was carrying 50% of the ORTO circuits, while the other 50% was carried by the neighboring console. Therefore, the operator of console #1 and the operator of console #2, could access 100% of the ORTO circuits, since 50% of the circuits were terminated at Bay #B of Console 1 and the other 50% at Bay #B at Console 2. Similarly, for the other operators since we had multiple appearances. The fifth panel, below jackfield "A", was another jack panel, for jackfield "B" and jackfield "C" with 96 jacks of the type shown in Fig. 4.7. The lower row of the panel was identified as jackfield "C" for reasons which will be explained later in this section. All the jacks of the panel were wired through the IDF to the (LP) jacks of jackfield "A-C" as shown in Fig. 4.7, on a permanent basis. This jackfield was designed to handle the UNLEASED circuits. In order to send an unleased program overseas, a patch cord had to be plugged between the selected type of circuit from jackfield "A" and the appropriate jack of jackfield "B". It would automatically appear at jackfield "A-C" for control purposes in Bay "A", and therefore to the channel banks, for transmission. The same operation was required for an unleased circuit patched to jackfield "C" except that jackfield "C" was already carrying live traffic channels, and before such a patching, the channel had to be cleared by the busy switch of the supervisory control. Use of jackfield "C" was not necessary unless there was a shortage of loops or channels via jackfield "B". In effect, there were a total of 72 traffic channels spread at random over the ten ISPC consoles as an additional stand-by capacity if the need would arise. The fact that these jacks were carrying live channels led to the creation of jackfield "C", to avoid accidental human interference.

Finally, the lowest panel was a 96 jack panel as in Fig. 4.11 where all the trunks and other auxiliary terminations were connected, as shown in in Fig. 4.12 and Fig. 4.13.

4.2.5 The Test Tone Network

For an operator of an International sound-program center, one of the indispensable tools is the test tone source.

It is essential that a frequency source of 800 Hz or 1000 Hz is available, for the line-up procedures of an international sound-program circuit. Technical instructions for transmission line-up procedures and objectives are outlined in Chapter VII.

In the present case the problem was to provide the required test tone levels of 800 Hz and 1000 Hz to all ten ISPC operators for simultaneous use, if necessary, using one source only for each frequency.

The answer to that problem was to design one test tone distribution network for each frequency, which would provide the required levels to all ten console operators.

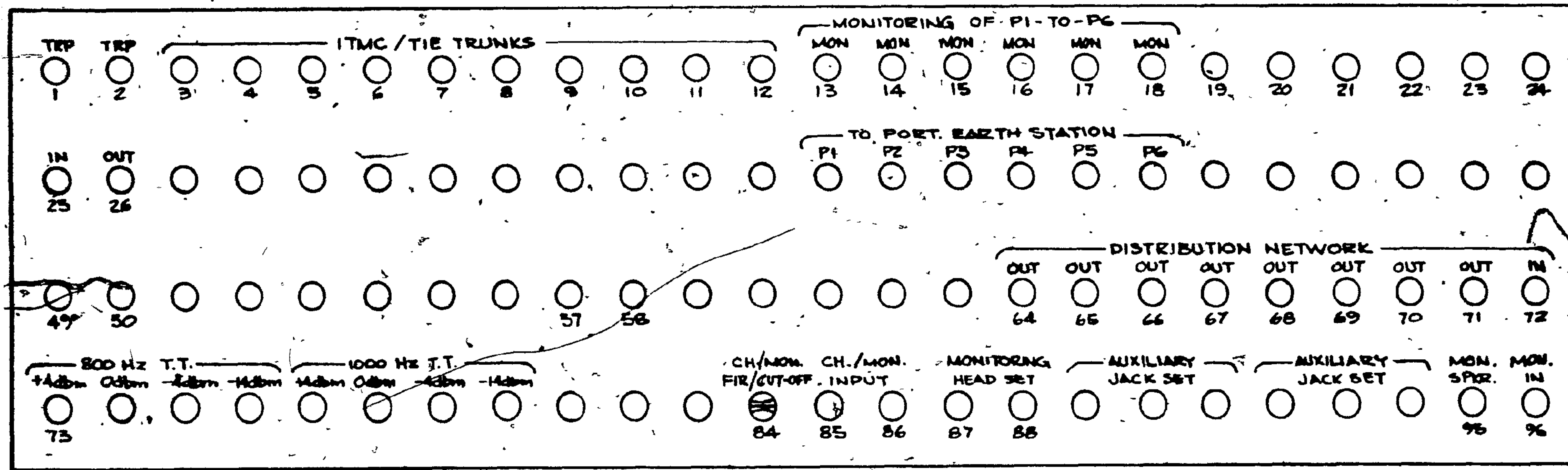


Fig. 4.11 — Test Panel Layout.

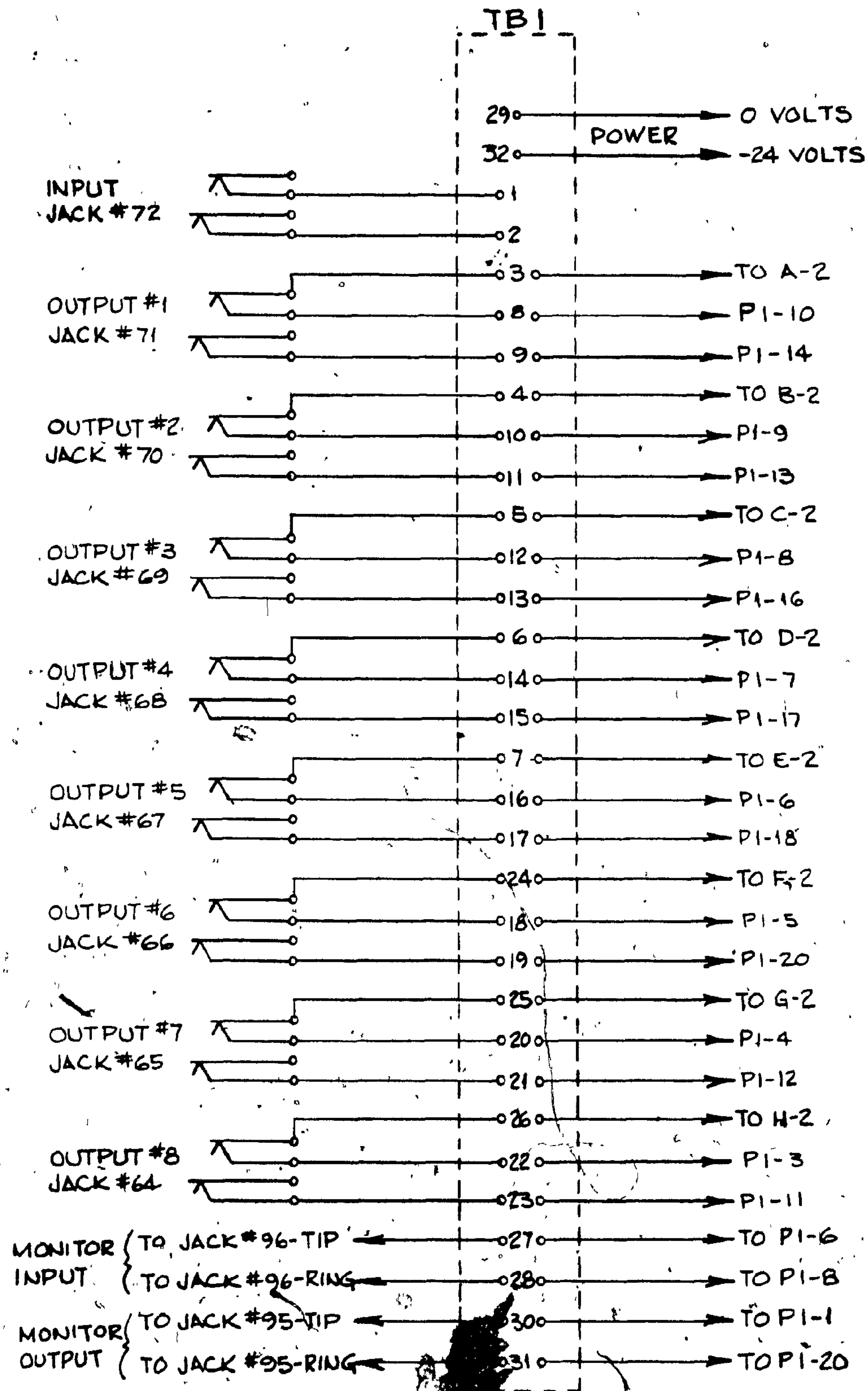


Fig. 4.12 — Program Amplifier and Distribution Network Wiring.

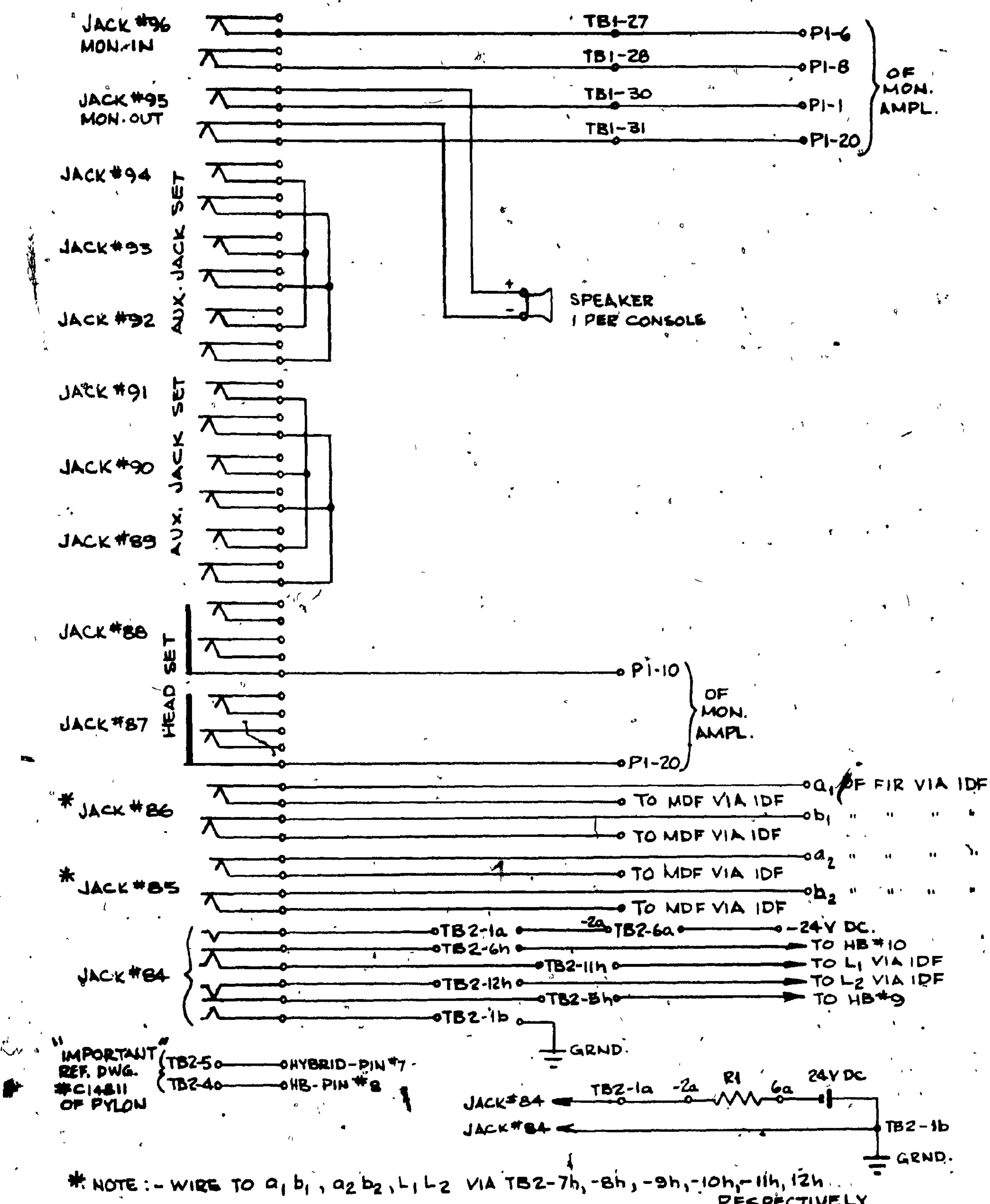


Fig. 4.13 — Monitoring Facilities Wiring.

The equipment available was:

a) one Milliwatt reference generator NE-71A for 1000 Hz

b) one oscillator unit, adjustable, HP-204C for 800 Hz

c) twenty audio amplifier units from Bayly Engineering, type #2835A

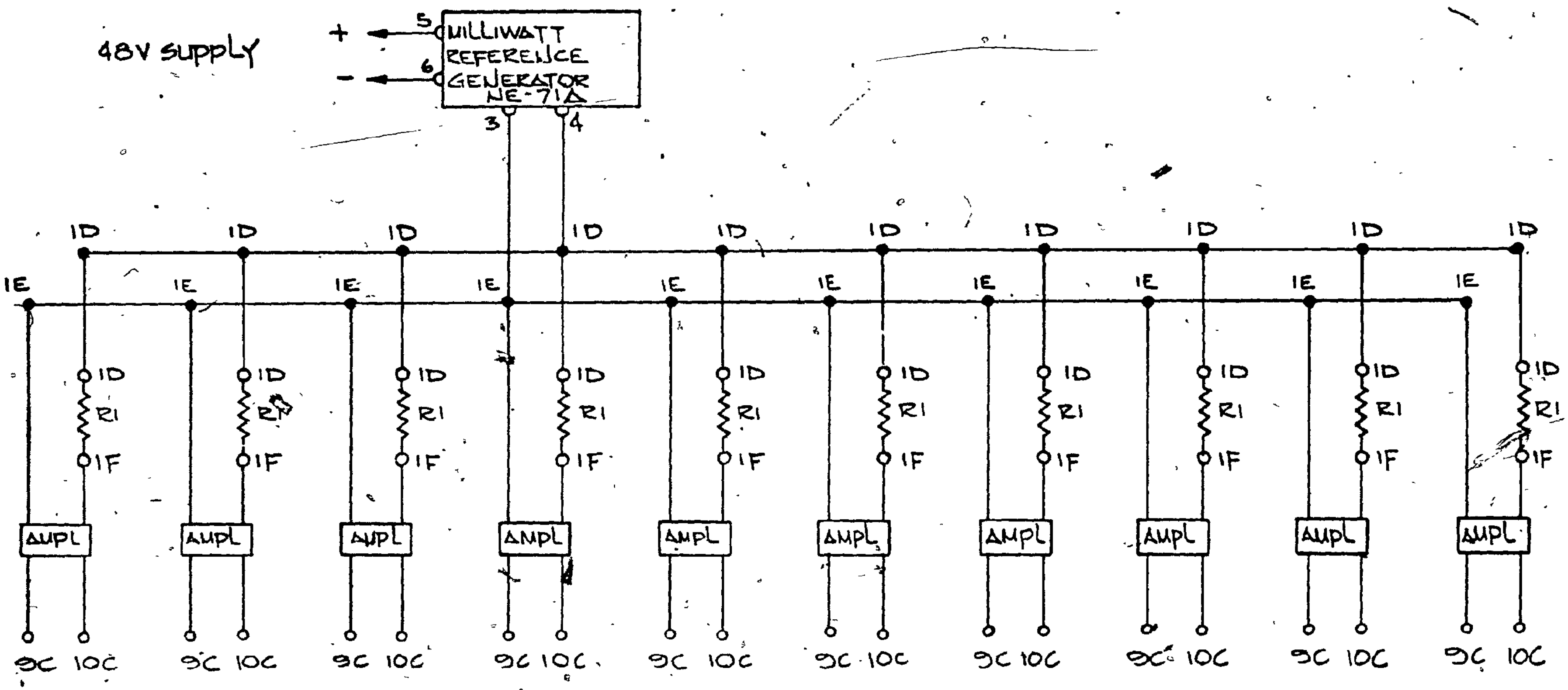
The distribution network for the 1000-Hz test tone is illustrated in Fig. 4.14 and it was designed to present a load impedance approximately equal to 300 ohms which was the recommended load by the manufacturer.

Having therefore a parallel network of ten 600 ohms amplifiers and ten resistors of 2400 ohms each as shown in the figure, the net load impedance to the source is 300 ohms. The output from each amplifier is 600 ohms impedance and a variable gain from -2 db to 38 db nominal.

The distribution network for the 800 Hz test tone is illustrated in Fig. 4.15 and it was designed to present a 600 ohms load impedance to the source. The source was 600 ohms impedance, as well as each audio amplifier used. The distribution network therefore was made of ten audio amplifiers in parallel and each amplifier having a 5600 ohms resistor in series with the source, thus giving a net load impedance to the source of 600 ohms as shown in the figure. The output from each amplifier is also 600 ohms impedance and the gain variable from -2 db to 38 db nominal.

The problem therefore of providing a distribution network with ten outputs from each frequency source was solved.

The two sources were mounted at the main console with the distribution network. Each console was in turn provided with the output of one amplifier from the 1000 Hz distribution network and that of one amplifier from the 800 Hz distribution network. The 1000 Hz test tone supply was wired to pin #9C and pin #10C of terminal block TB2 of each console. The



Notes: 1) Rl is 2400 ohms 1/4 watt ±1% one per console.

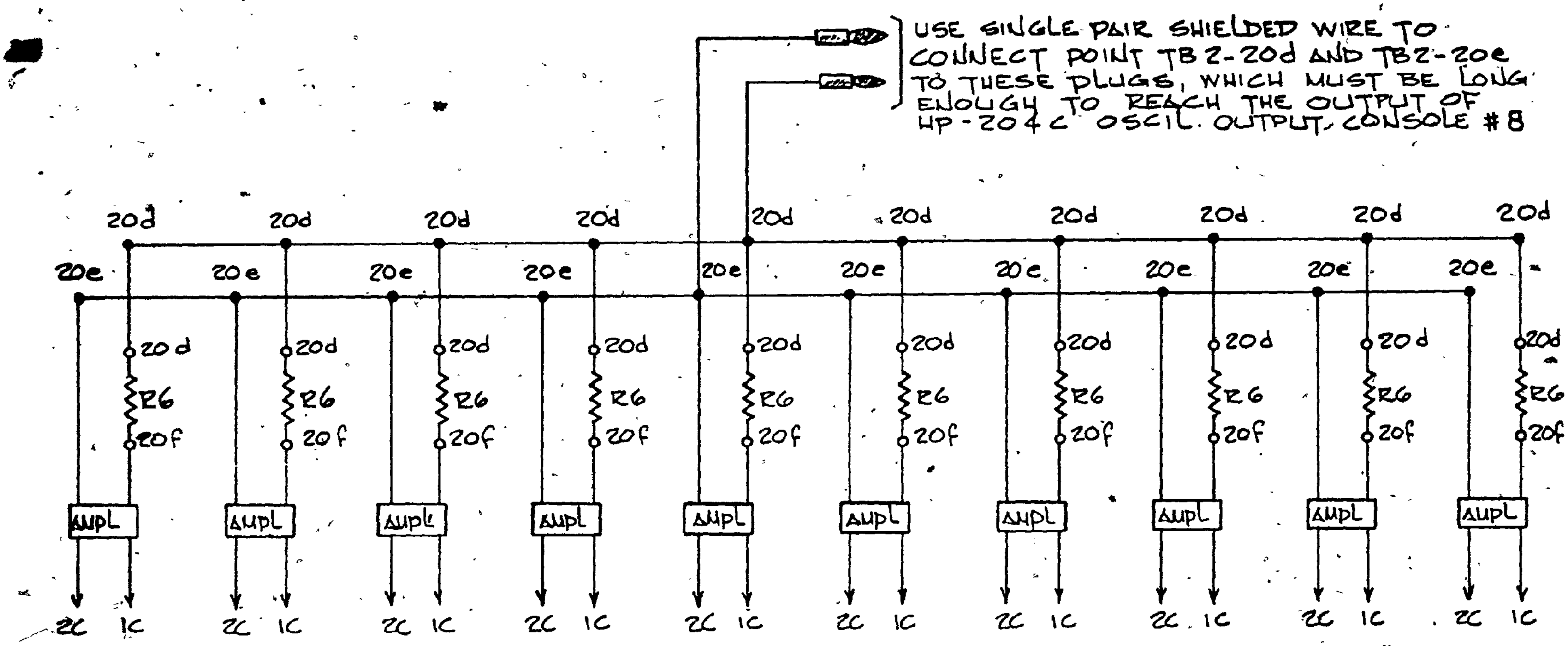
2) Install NE-71A at the Rear of Console #H (Main Console).

3) Install one Bayly Amplifier Type 2835-A per console.

4) Use single pair shielded wire for all connections. One end of the shield on every run should be connected to the frame of the unit.

5) Points ID, IE, IF, 9C and 10C are pins on TB2 of each console.

Fig. 4.14 — Test Tone Supply Wiring Network (1000 Hz).



Notes:
1) R6 is 5600 ohms 1/4 watt ±1% one per console.
2) Install one Bayly amplifier type 2835-A per console.
3) Wire banana plugs on main console #8 only, T1P and T1P to the tone distribution network as shown above. (i.e. between TB2-20e, -20d and HP-204c Oscil. Output of Console).
4) Use single pair shielded wire for all connections. One end of the shield on every run should be connected to the frame of the unit.
5) Points 20d, 20e, 20f, 1c and 2c are pins on TB2 of each console.

Fig. 4.15 — Test Tone Supply Wiring (800 Hz).

800 Hz test tone supply was wired to pin #1C and pin #2C of the same terminal block TB2 on each console. (TB2 was a terminal block with an array of pins 20 x 8. For reference, the horizontal rows were numbered from 1 to 20 and the vertical columns from a to h, as shown in Fig. 4.16.

The next problem faced with was to provide the operator of each console with the two test tones at the required power levels and make them available on the jacks of the test panel for easy access. The levels requested by operations were:

800 Hz	1000 Hz
+ 4 dbm	+ 4 dbm
0 dbm	0 dbm
- 4 dbm	- 4 dbm
- 14 dbm	- 14 dbm

The source was adjusted to give an output of 1.2 volts r.m.s. at 600 ohms load, that is, 3.8 dbm power level. The gain of the audio amplifiers was in turn set to 0.2 db in order to achieve the required output level of 4.0 dbm for each source. The output of each audio amplifier of the distribution network for 1000 Hz was wired to tip and ring of jack #77 at the test panel of each console. (For reference see Fig. 4.17 and Fig. 4.19).

Similarly, the output of each audio amplifier of the distribution network for the 800 Hz was wired to tip and ring of jack #73 at the test panel of each console. (For reference, see Fig. 4.18 and Fig. 4.19).

Thereafter, the spring contacts (N.C.) of the tip and ring of jack #77 were wired to pin #3d and pin #3e of the terminal board TB2 of each console. This point was the input to a three stage attenuation pad designed to give a loss of 4 db at the output of the first stage wired to jack #78 for 0 dbm level. Then the spring contacts (N.C.) of jack #78 were wired to pin #5d and pin #5e which was the input to the second stage of the attenuation pad for a further loss of 4 db in order to get from the output a level of -4 dbm and wire it to tip and ring of jack #79. Then the spring contacts (N.C.) of that jack were wired to pin #7d and pin #7e which was the input to the third stage of the attenuation pad designed to give a 10 db loss, that is at pin #15c and pin #16c of the terminal block the power level of the 1000 Hz test tone was -14 dbm. That was in turn wired to tip and ring of jack #80 and its spring contacts were terminated in a 600 ohms load, as shown in Fig. 4.17.

Similarly, the 800 Hz distribution network was connected to an identical type of attenuation pads but appearing at jacks #73, #74, #75 and #76 of the test panel, as shown in Fig. 4.18 and Fig. 4.19.

Each operator therefore has at his disposal two test tone frequencies, one of 800 Hz and one of 1000 Hz, appearing at four different power levels at the test panel as follows:

Test-Tone Source	Test-Tone Level and Jack Number			
	+4 dbm	0 dbm	-4 dbm	-14 dbm
800 Hz	Jack #73	Jack #74	Jack #75	Jack #76
1000 Hz	Jack #77	Jack #78	Jack #79	Jack #80

The design stages and details of the particular pads used for both distribution networks are shown in Appendix II.

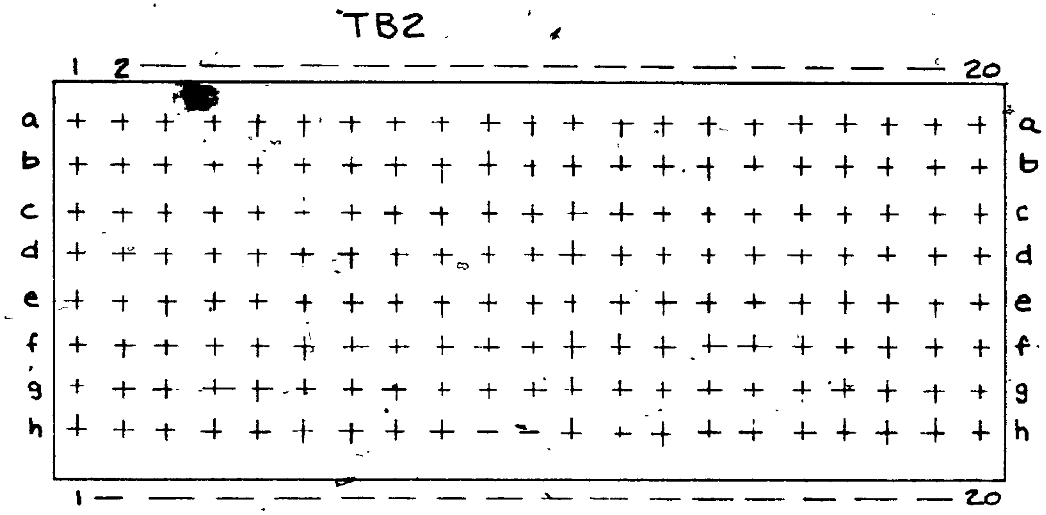
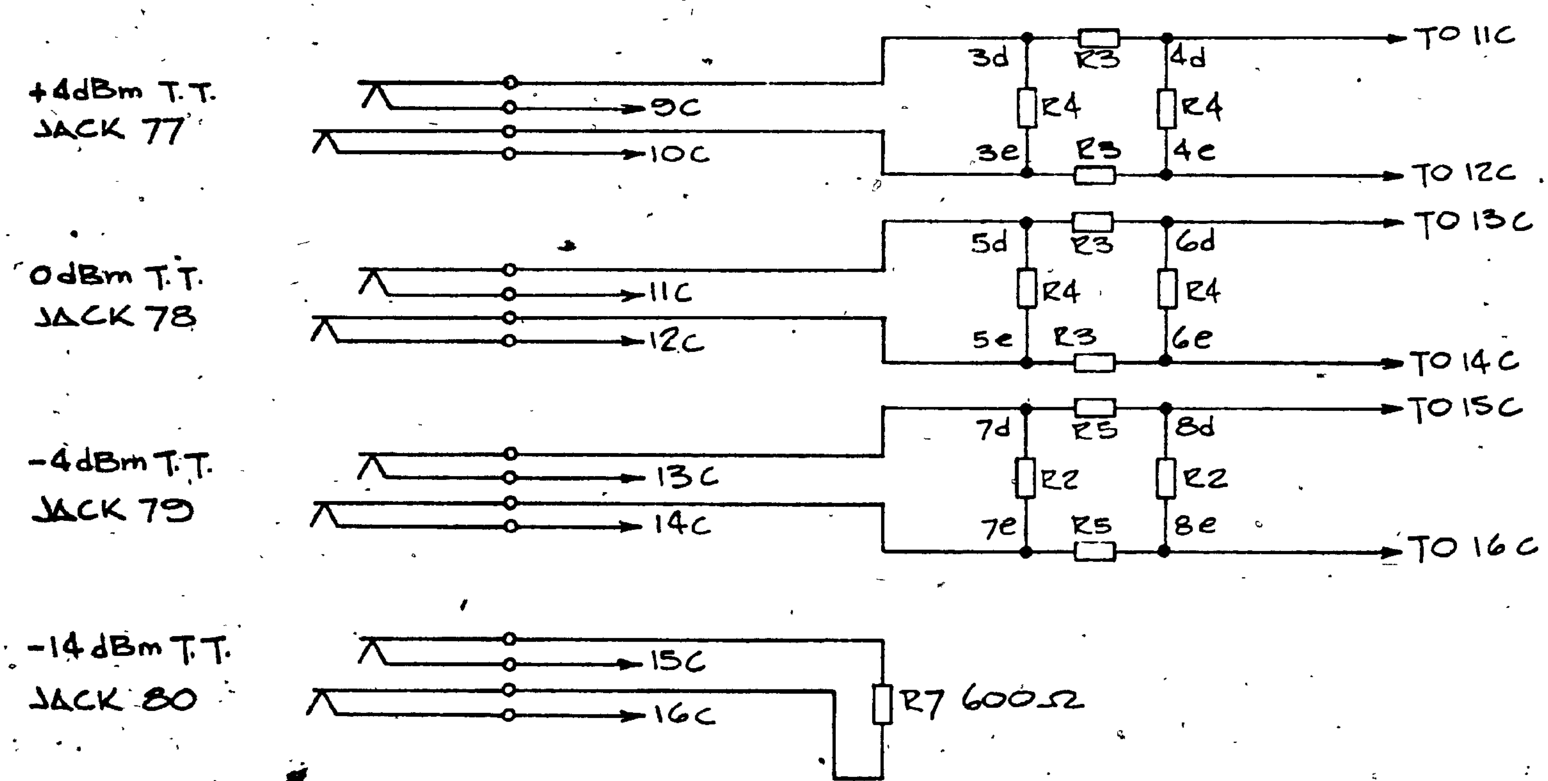
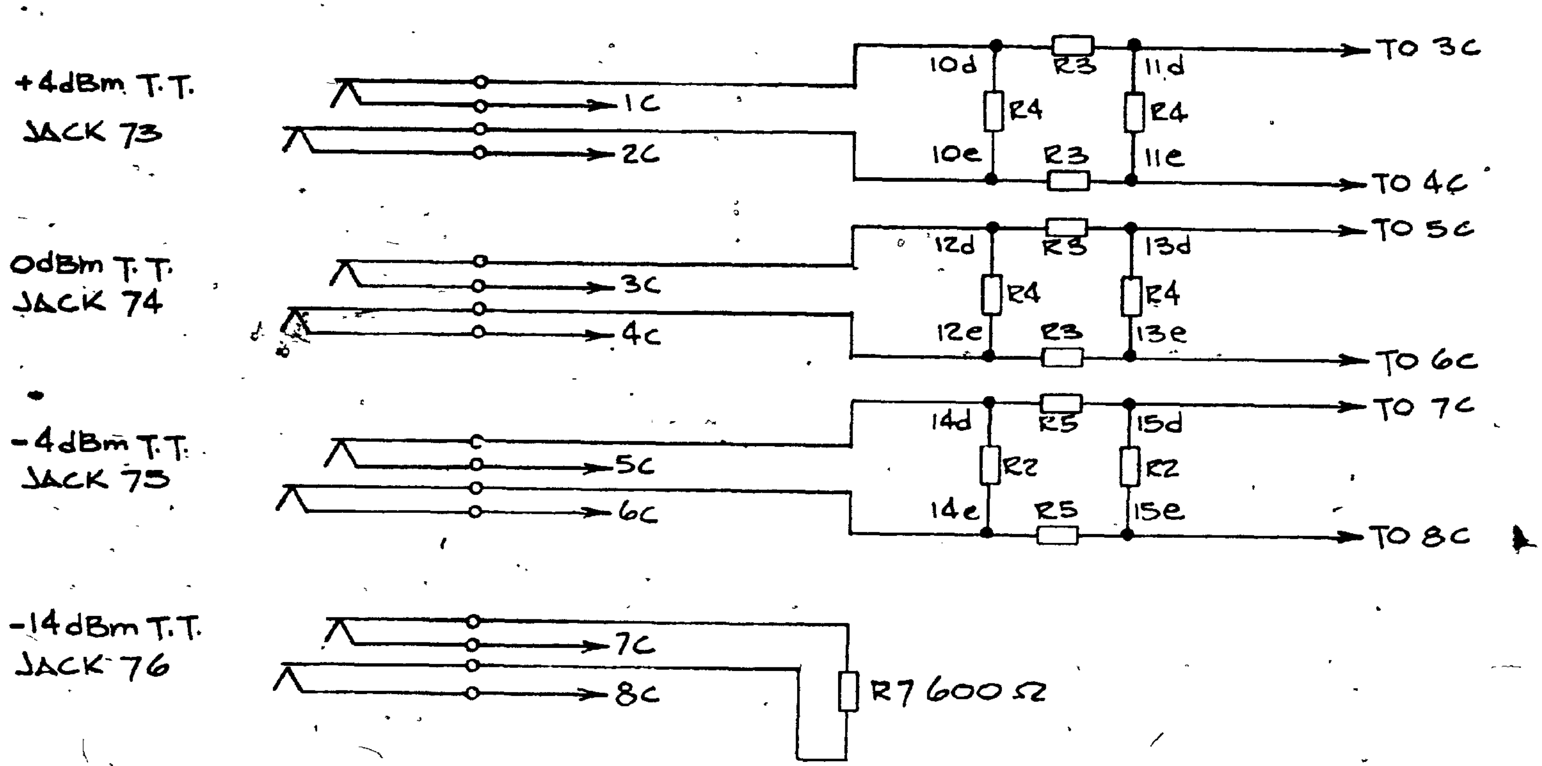


Fig. 4.16 — Terminal Block TB2 Pin Identification.



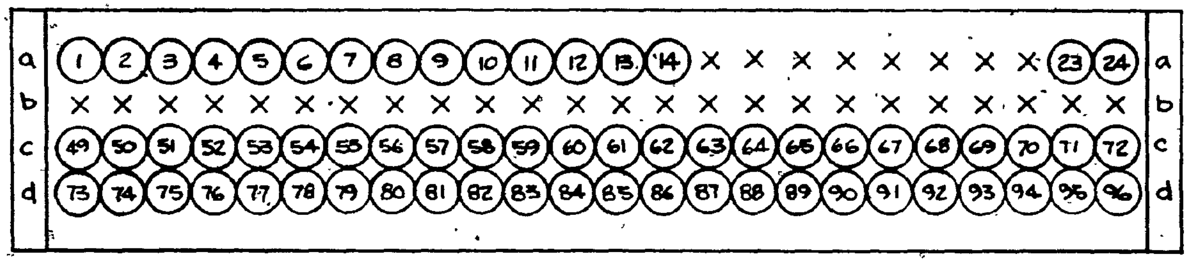
<u>Notes:</u>
1. R2 is 1154.9 ohms 1/4 watt ±1% Resistor.
2. R3 is 143.0 ohms 1/4 watt ±1% Resistor.
3. R4 is 2651.6 ohms 1/4 watt ±1% Resistor.
4. R5 is 426.9 ohms 1/4 watt ±1% Resistor.
5. R6 is 5600 ohms 1/4 watt ±1% Resistor.
6. R7 is 600 ohms 1/4 watt ±1% Resistor.
7. Tip and ring of Jack #77 wired on TB2-9C and IDC respectively.
8. For generator and amplifier connections see Fig. 4.14.
9. Terminal points shown above are pin numbers of TB2.

Fig. 4.17 — Test Tone Attenuator Pads Wiring (1000 Hz).



Notes:
1. R2 is 1154.9 ohms 1/4 watt ±1% Resistor
2. R3 " 143.0 " " " "
3. R4 " 2651.6 " " " "
4. R5 " 426.9 " " " "
5. R6 " 5600.0 " " " "
6. R7 " 600.0 " " " "
7. Tip and Ring of Jack #73 wired on TB2-1C and -2C respectively.

Fig. 4.18 — Test Tone Attenuator Pads Wiring (800 Hz).

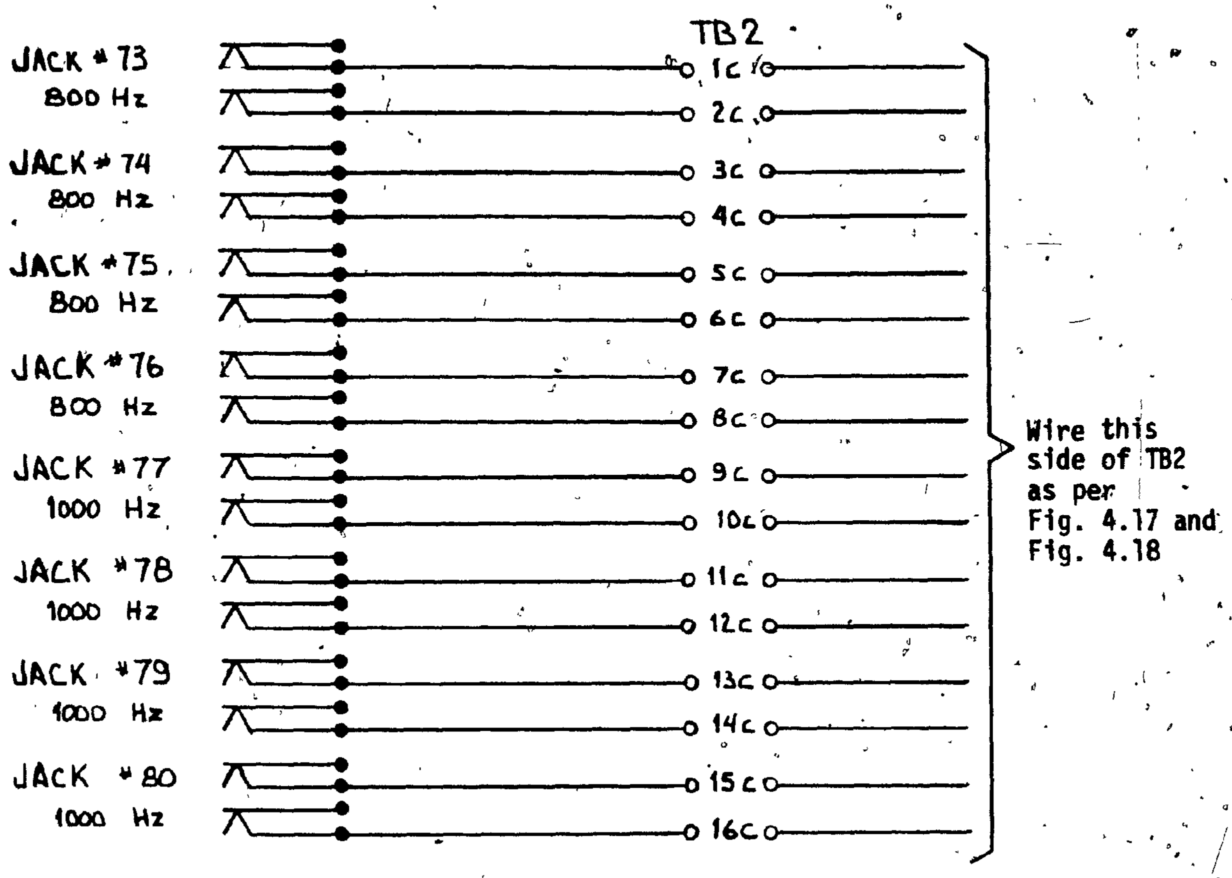


"96 - Aux. Jacks" Panel - Front View.

Notes:

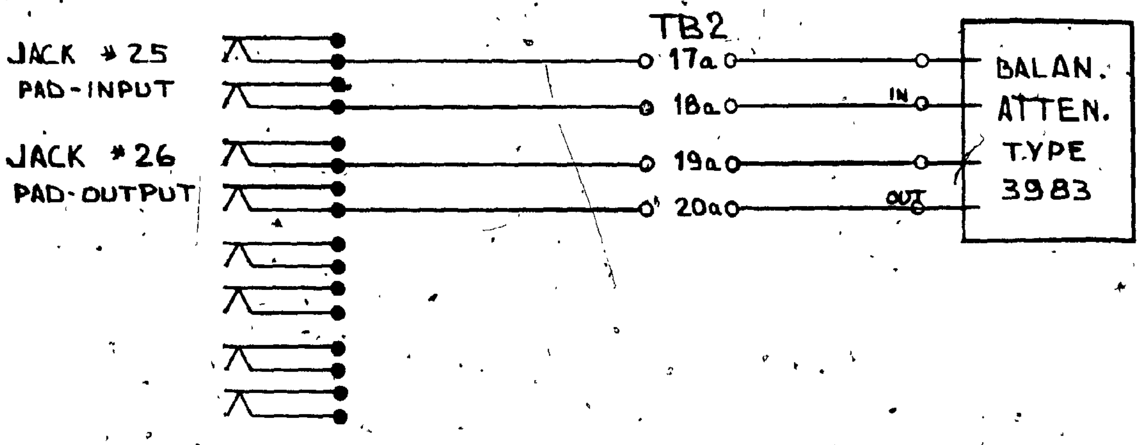
1. Jack #73, #74, #75, #76, wire tip and ring to T.T. 800 Hz, 4 levels) as per Fig. 4.20
2. Jack #77, #78, #79, #80, wire tip and ring to T.T. 1000 Hz, 4 levels)
3. Jack #72, wire tip and ring to program amplifier input: TB1-1, TB1-2.
4. Jack #64 through to #71, wire as shown in Fig. 4.12.
5. Jack #96, wire tip and ring to monitor amplifier input: TB1-27, TB1-28) as per Fig. 4.12 and 4.13
6. Jack #95, wire tip and ring to monitor amplifier output: TB1-30, TB1-31)
7. Jack #92, 93, 94, wire in parallel tips and rings as per Fig. 4.13
8. Jack #89, #90, #91, wire in parallel tips and rings as per Fig. 4.13
9. Jack #1 - #12, wire tip and ring via IDF to FRP test panel
10. Jack #13 - #24, wire tip and ring to ITMC, via IDF
11. Wire Jack #84, #85, #86, #87, as shown in Fig. 4.13 and Fig. 4.16
12. Wire Jack #25, #26, as per Fig. 4.21.

Fig. 4.19 — Test Panel Wiring Information.



Note: For the wiring above use shielded, twisted-pair copper wire.

Fig. 4.20 - Test Tone Supply Wiring Via TB2



Notes

1. Balanced attenuators (pads) are rack mounted on 19" shelf five units per shelf.

2. One shelf is mounted on console #3-A and the other on console #9-A. See Table 4.2.

3. Wire one attenuator per console as follows:

   a) console #1-A, #2-A, #3-A, #4-A, and #5-A, from the shelf located on Bay #3-A.

   b) console #6-A, #7-A, #8-A, #9-A, and #10-A, from the shelf located on bay #9-A.

Figure 4.21 - Pads Wiring and Location.

4.2.6 The International Telephones

Each operator of the International Sound Program Center was provided with direct access to the international telephone network. During line-up of circuits or circuit trouble investigation, direct contact with the operator of the distant end ISPC was very important. It could also be done through the normal city lines via Bell-telephone, except that it might be time consuming or even difficult at times because of the high demand for overseas calls during the games.

To minimize the risks, special lines were reserved in our International exchange for this particular application. A total of 12 lines were necessary. Ten for the ISPC operators, one for the Fault Report Point (F.R.P.) console, and one for the Program Booking Center (PBC). An FIR was permanently assigned to each of these lines and it was wired to each console directly. The telephone set used for these lines was not the common type of telephone. A special type of set was required with a multi-frequency tone generator and signalling as per CCITT frequency specification No. 5.

These sets were made by PYLON Electronic Development, panel mount model #A14810.

The panel unit mounts the following:

- MF tone generator PCB Pylon #A14840
- Telephone set Hybrid
- MF tone pad
- Off-hook on-hook lever switch
- Telephone jack to accept an operator's head set.

The panel unit was intended for 19" rack or console mounting at the right end of the panel. The panel was mounted on the inclined space of Bay #B, of each console, between the writing desk and the jackfields.

SPECIFICATION

Multi-Frequency Numerical Code CCITT

Digit	Frequencies
1	700 + 900
2	700 + 1100
3	900 + 1100
4	700 + 1300
5	900 + 1300
6	1100 + 1300
7	700 + 1500
8	900 + 1500
9	1100 + 1500
0	1300 + 1500
*	1500 + 1700 - ST
#	1100 + 1700 - KP1

Electrical

Frequency Accuracy	-	± 0.5%
Frequency Distoration	-	5% Max
Frequency Stability	-	± 0.1%
Temperature Range	-	0 to 50°C
Single Frequency level	-	- 8dbm ± 0.5 db @ 600 ohms
Dual Frequency level	-	- 5dbm ± 1 db @ 600 ohms
Voltage Input (with transformer)	-	105 - 130 Vac 60 Hz
(without ")	-	12 - 21Vac 50-60 Hz or 16-30 Vdc.
Panel Unit Jack	-	NE 200A equipped with 2-NE 364 jacks. Accepts head set terminated in 396A plugs or equivalent.

Mechanical

Desk Telephone A14820 comprises a standard hand set ITT type 2500 or equivalent attached to a desk mounting enclosure 9" x 6 3/4" x 1 1/2" high.

The enclosure houses the printed circuit board and is finished in ivory enamel.

The Panel Unit is for 19" rack mounting occupies 8 3/4" rack space, has front projection 1" and rear projection 3 1/4". Finish ivory enamel over cadmium plate and chromate.

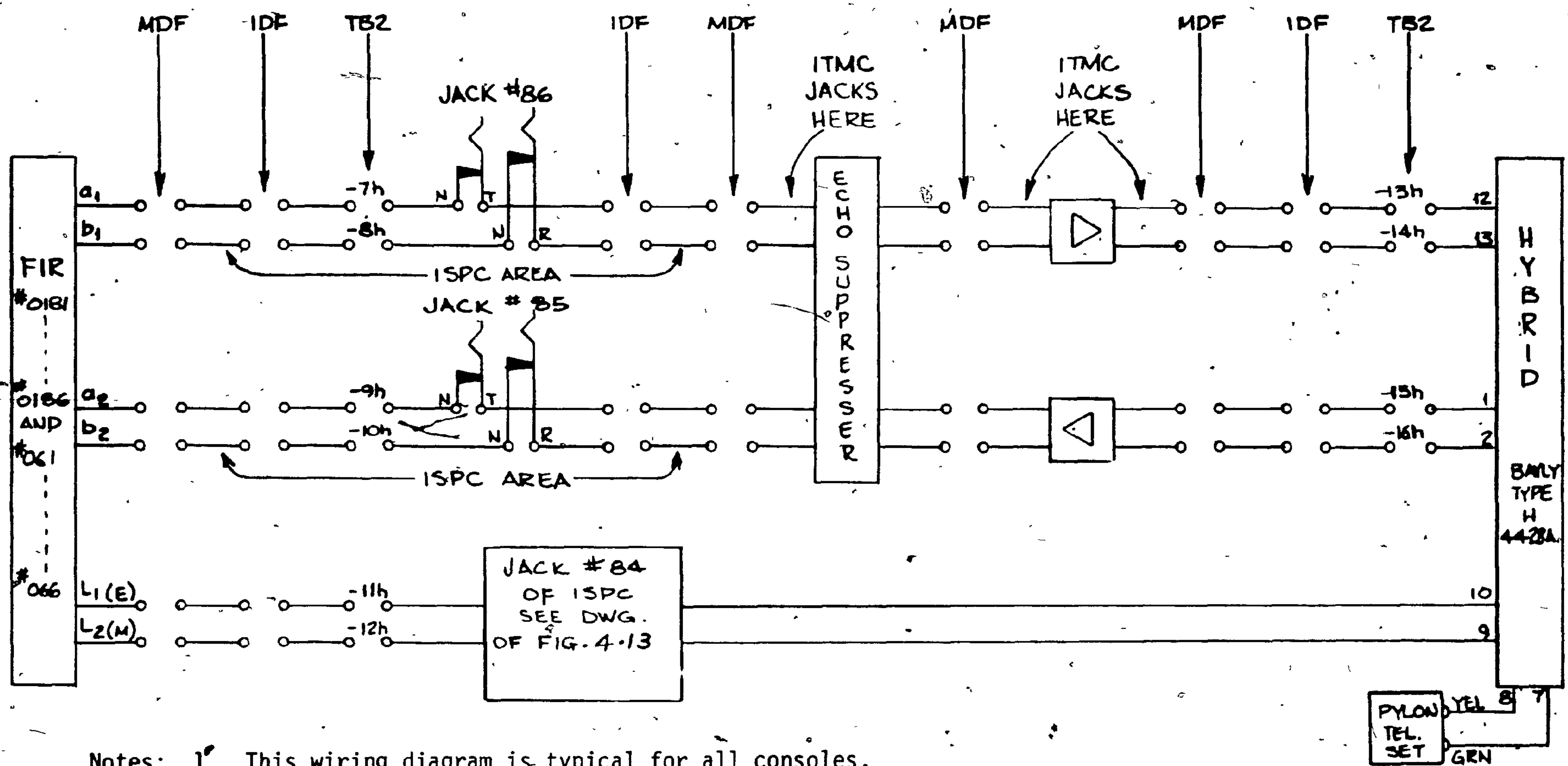
The ISPC operator could reach therefore any overseas number by composing on the touch-tone the "KP1" signal then the country's code then the area code and number and finally the "ST" signal which means "START" to process the number.

The circuit arrangement, wiring and interconnections are shown in Fig. 4.22 and Fig. 4.24 for the ISPC consoles, and in Fig. 4.23 for the TRP console and the Program Booking Center (PBC).

4.2.7 Order Wire Access

Two types of private line circuits were used in our network facilities. The OMNI-ORDER-WIRES and the RING-DOWN order wires.

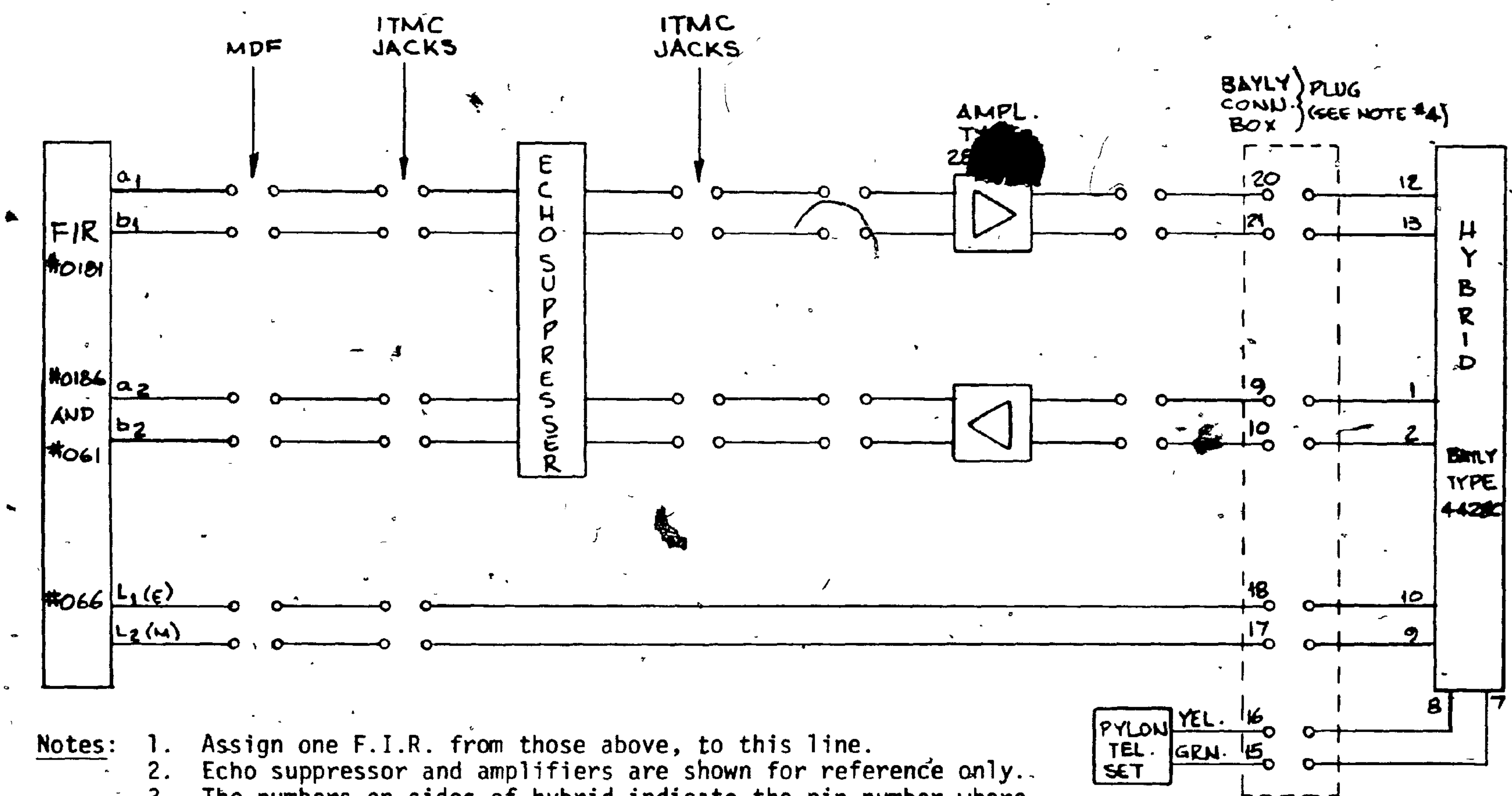
For the purpose of this report, the main difference among the technical characteristics of the two types is in the signalling part. The OMNI order wires are multi-party lines with selective ringing, via a rotary dialing device from any of the participating stations. The RING-DOWN circuit private lines are usually two-party lines without dialling facilities. Signaling is achieved by the application of 20-Hz ringing current to the trunk leads by the operator to signal the distant operator that a trunk call is waiting.



Notes: 1. This wiring diagram is typical for all consoles.

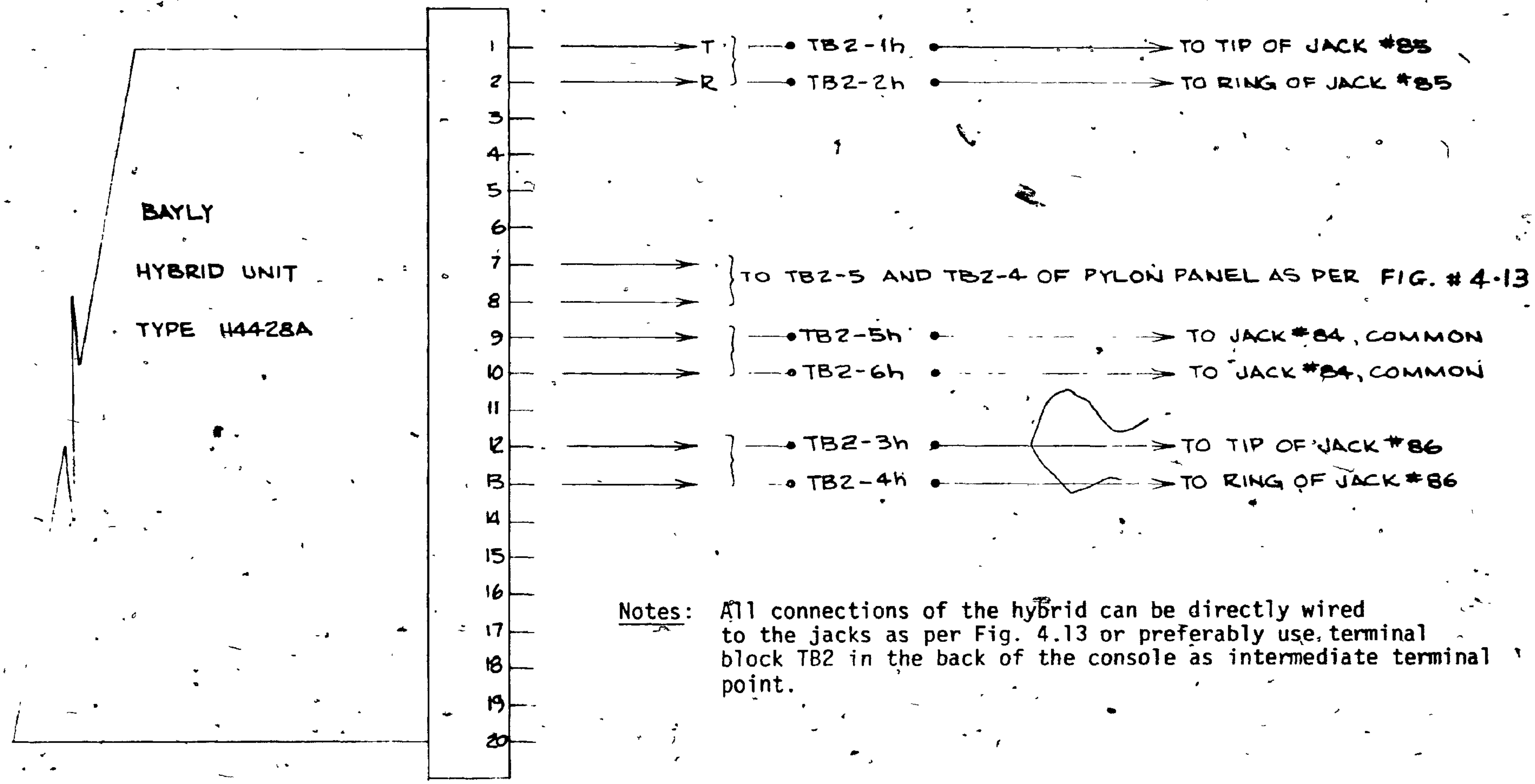
2. The ITMC jacks location shown by arrows for reference only.

Fig. 4.22 — Typical Private International Line Diagram (Pylon Sets).



Notes:
1. Assign one F.I.R. from those above, to this line.
2. Echo suppressor and amplifiers are shown for reference only.
3. The numbers on sides of hybrid indicate the pin number where the connection of each wire from the FIR shoiuld be.
4. Hybrid is to be plugged in the Bayly mounting box which has a conn. plug with pin no. corresponding to those shown above.

Fig. 4.23 — Typical Private INT/NAL Line Diagram (Pylon sets) for PBC & TRP.



Notes: All connections of the hybrid can be directly wired to the jacks as per Fig. 4.13 or preferably use terminal block TB2 in the back of the console as intermediate terminal point.

Fig. 4:24 — Hybrid Wiring Information.

More advanced ring down order wires made use of the carrier-derived trunks with suitable voice-frequency ringers for transmission of the ringdown signal over the carrier trunks.

From the existing order wires which were normally terminated at the ITMC of the gateway terminal only 5 OMNI type and 2 ring down type were required for the ISPC, namely:

1) East regional	OMNI Type
2) Commonwealth	
3) West regional	
4) Bermuda & Mill-Village	
5) COMSAT	
6) London ISPC	Ring Down Type
7) Washington COMSAT/OP-CEN	

The task therefore was to extend these order wires to the ISPC and make them an integral part of the system's facilities. The extension was a straight forward task. They were interconnected from the ITMC to the Trouble Report Point (TRP) console of the ISPC via the MDF and IDF.

The TRP operator, therefore, could establish or receive any calls within the order wire network if the need would arise. The ISPC operators, however, could not access these lines and it would create efficiency and delay to such a degree that the purpose of relocating the order wires would be defeated. On the other hand, it would be financially prohibitive to terminate all the order wires in a parallel multiple termination for all the ISPC operators. An effort was made by experimental and research work for economical ways and means to provide all the operators with access to the order wires from each console. As a result, a VOICE STATION COUPLER type QCS2B, made by Northern Electric, was used to access the order-wires from each console via a PABX unit. The voice station coupler (RDK) is a versatile device designed to couple customer-provided equipment into a central office or branch exchange (PABX). (See Appendix III for Northern Electric (NEDCO) brochure).

Because of the fact that the voice station coupler was designed to work on 2-wire lines and the order wires were 4-wire circuits, it was necessary to convert the order wires from 4-wire to 2-wire via a hybrid unit (2W/4W terminating set) before connecting them to the coupler. In addition, two unidirectional audio amplifiers were interconnected between the hybrid and the order wire equipment: one at the transmit path and one at the receive path as shown in Fig. 4.25. In turn the two wire side of the hybrid was connected to the voice station coupler (RDK) at terminal "CT" and "CR" as shown in Fig. 4.25. The voice part of the order wires therefore was connected to the PABX via the voice station coupler. Any extension telephone of the PABX network could access the RDK, by dialing a two-digit number which was assigned to each unit.

The next problem was to come up with a circuit and auxiliary devices which could be combined with the operational characteristics of the RDK, in order to be able not only to access but to control the order wire calls. That was achieved out of experimental work done, using the RDK on live order wire circuits and the telephone as follows:

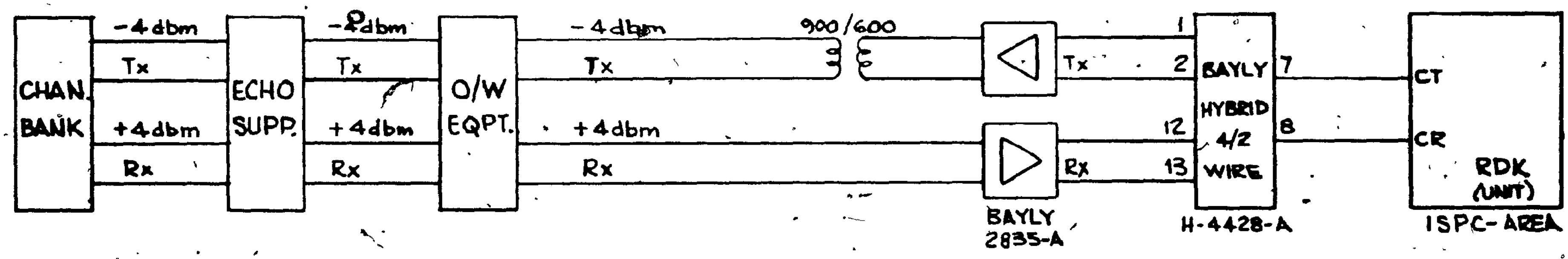


Fig. 4.25 — Order Wire, Typical Circuit (OMNI-type).

a) Strap-in:	REPD terminals of RDK	
b) Strap-out:	CTR	" "
c) Strap-out:	RS1 & RS4	" "
d) Strap-out:	RS2 & RS3	" "
e) Strap-out:	TAM	" "

As shown in the technical information table provided by Northern, for the options of the voice station coupler (see Table 4.3).

After completion of the strapping work it was observed that, when an extension station of the PABX was dialing the RDK number the RDK terminals RU1 and RU2 were providing a short while ringing. At idle condition these two terminals were open dry contacts. It was also observed that, to answer an RDK contact OH1 and OH2 had to be shorted. Finally, it was verified that when a calling extension of the PABX was answered, by shorting the OH1 and OH2 terminals, the caller was automatically connected across terminal CT and CR where the voice circuit of the order wire was terminated. The caller could remain connected across the order wire until the RDK was restored to the idle mode, which was possible by removing the short from terminal OH1 and OH2.

It was therefore necessary to design a circuit that would make these features of the RDK operational in association with the features, and options of the PABX. The features of interest of the PABX were the following:

a) Indication of busy stations with illuminated numbers

b) Conference network

c) Add-on feature of two remote stations via the operator of the PABX console.

Northern Electric

Technical information

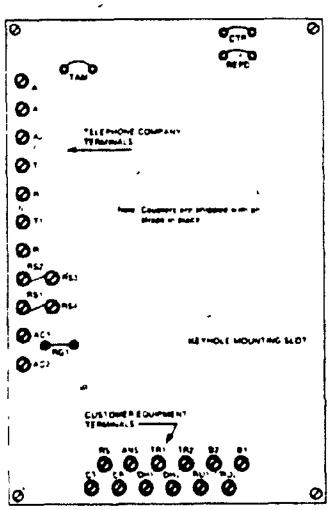
QCS2B Voice Station Coupler

Selection of USOC code arrangements

Strap connections inside coupler

Functional group	USOC code	TAM	RG1	REPD	RS-1 RS-4	RS-2 RS-3	CTR	Description
Telephone answering machines	RDMZR	√	X	√	X	X	X	Recorder service
	RDMZY	√	X	√	X	X	X	Recorder service
	RDY	√	X	X	X	X	X	Recorder service
	CD6	√	X	√	X	X	X	Incoming auto attendant
Repertory diallers	SU7QW	X	X	X	X	X	X	Dialler service
	SU7VW	X	X	X	X	X	X	Dialler service
Alarm sending machines	SU6AQ	X	X	√	X	X	X	Without tones
	SU6AV	X	X	√	X	X	X	With tones
	STSQT	X	X	√	X	X	X	With tones
	STSVT	X	X	√	X	X	X	Without tones
Call extending eqpt	STCQX	X	X	X	√	√	√	
	STCVX	X	X	X	√	√	√	
Interface or key tel.	1A (CDA)	√	X	√	X	X	X	2 Way manual
	3A (CDN)	√	X	√	X	X	X	2 Way manual
	CD4	√	X	√	X	X	X	2 Way manual
	CD5	√	X	√	X	X	X	2 Way manual
	C2ACP	X	X	√	X	X	X	Multi-lead without bell set
	C2AKS	X	X	√	X	X	X	Multi-lead with bell set
Interface central office — loop start-PBX	CD7, 8, 9	X	X	√	X	X	√	Outgoing auto attendant
	*		√					Ringing on CT-CR
	*				X	X		20Hz (Special assembly) Ringing

√ = Strap in X = Strap cut * = In addition to any of the USOC codes



Terminal and strap locations

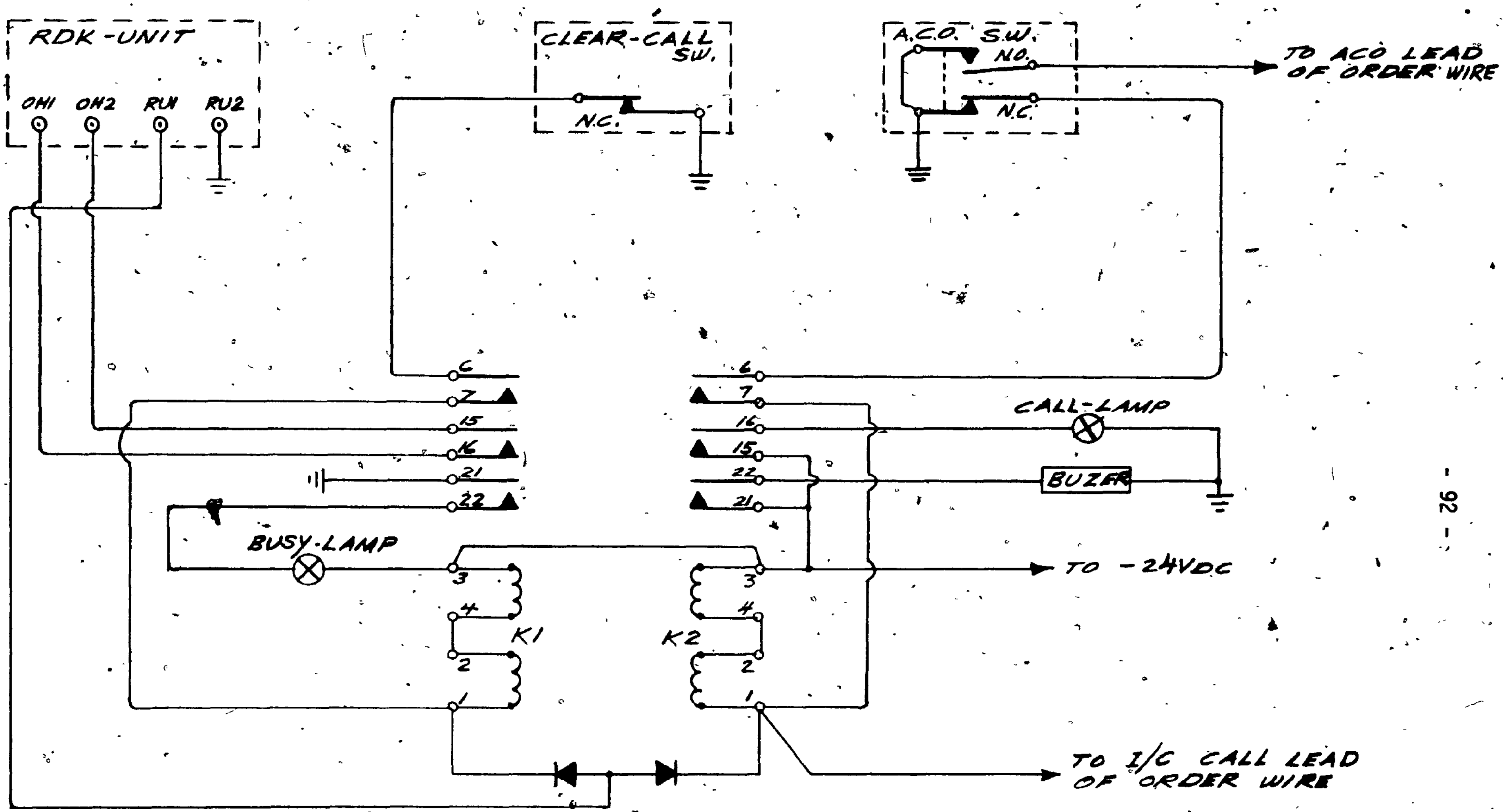
To set the coupler to any desired function, look at the table above, find the function and USOC code you require in the left hand columns. Next, set the wire strap connections as listed opposite the code. The figure shows you the locations of the straps under the coupler cover.

NEDCO

TABLE 4.3 — QCS2B Voice Station Coupler Options.

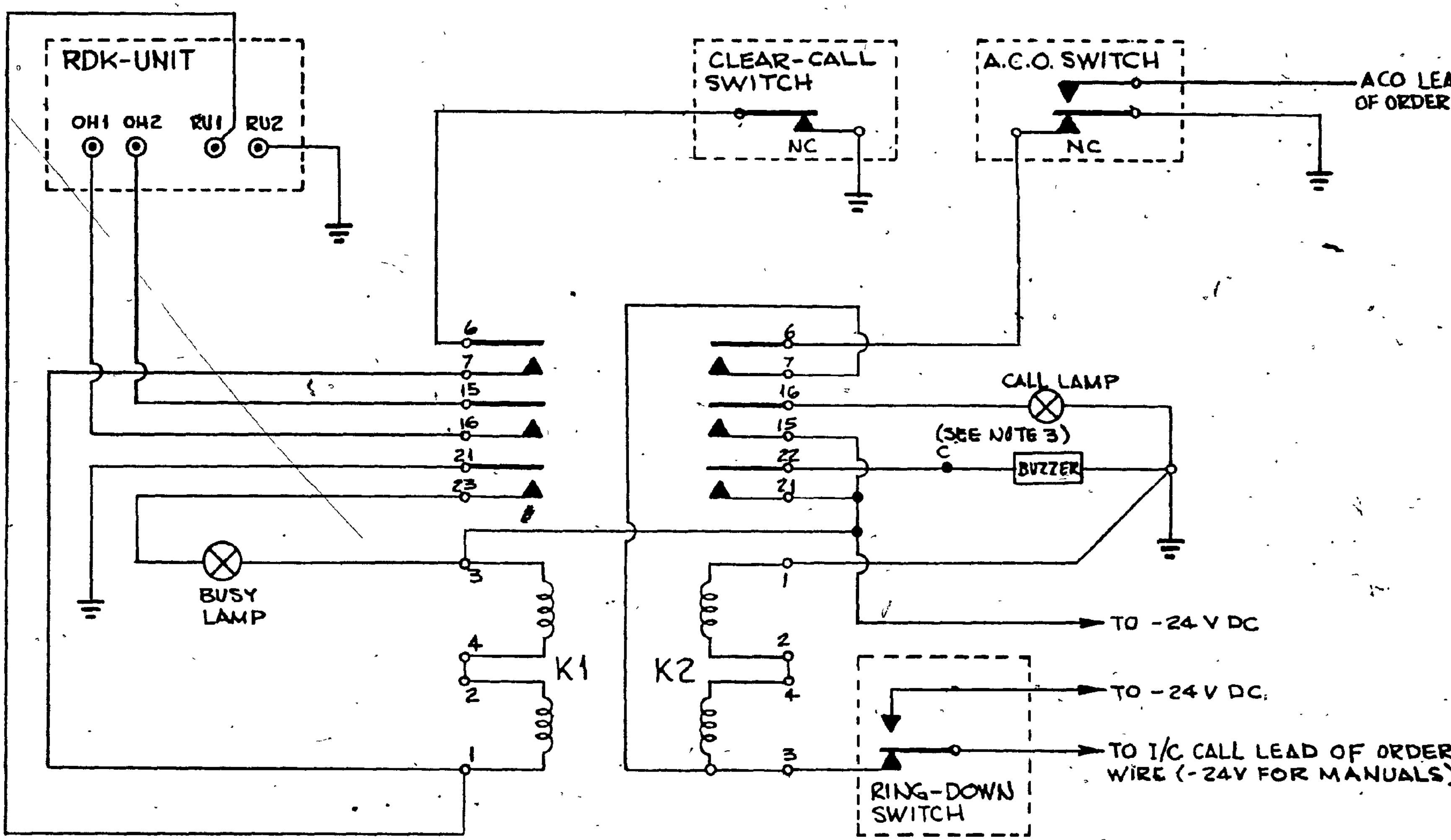
The circuit arrangement developed to interconnect and control the RDK and the signaling part of the order wires is shown in Fig. 4.26 for the OMNI type and Fig. 4.27 for the Ring-Down type. As shown, it is a combination of two relays, VARLEY type CAB/26W26, wired to selflock when energized.

In Fig. 4.26, when an incoming call of an order wire arrives it energizes relay K2 which in turn closes its contacts whereby the buzzer and the call lamps are turned on. It also selflocks by putting a ground to pin #1 via contact 6 & 7 of the same relay and N.C. contact of the switch of the alarm cut-off. The operator of the TRP, dials the RDK number corresponding to the calling order wire. The first ringing of the RDK provides a short at RU1 and RU2 and hence a ground to pin #1 of Relay K1 which energizes it. The contacts of K1 close and the busy lamp goes on, the relay selflocks by putting a ground to pin #1 through contact #6 and #7; of the same relay and through the N.C. contact of the CLEAR-CALL switch. At the same time, contact #15 and #16 shorts terminal OH1 and OH2 thus answering the RDK. The alarm and lamp of the order wire is silenced by putting a ground to the ALARM-CUT-OFF lead through the N.O. contact of the A.C.O. switch. The operator therefore is now able to talk to the order wire or if necessary to dial a remote extension, of any other operator, and by means of the "ADD-ON" switch to establish communication between the two ends and then drop-off. When the call was complete the operator could see on the display that the local station has dropped off and the call could be cleared by de-energizing K1. Relay K1 was de-energized by breaking the N.C. contact of the "CLEAR-CALL" switch. The control of incoming and outgoing order wire calls was done by the TRP console operator.



Notes: 1. For RDK Details see pg. 49 of NEDCO, Appendix III - (QCS2B Voice Station Coupler).
2. For order wire information see attached memo on OMNI O.W. tests of Oct. 9, 1975, as well as the memo on OMNI-O.W. experiments dated October 6, 1975.

Fig. 4.26 — Order Wire Controls Extension (OMNI-type).



Notes:
1. For RDK details see pg. 49 of NEDCO (QCS2B Voice Station Coupler).
2. For order wire info. see attached memo on OMNI O.W. tests of Oct. 9/75, as well as the memo on OMNI-O.W. experiments dated Oct. 6/75.
3. C is a common point (terminal) between buzzer and K2-22 of all O.wires.

Fig. 4.27 — Order Wire Controls Extension (Ring-down type).

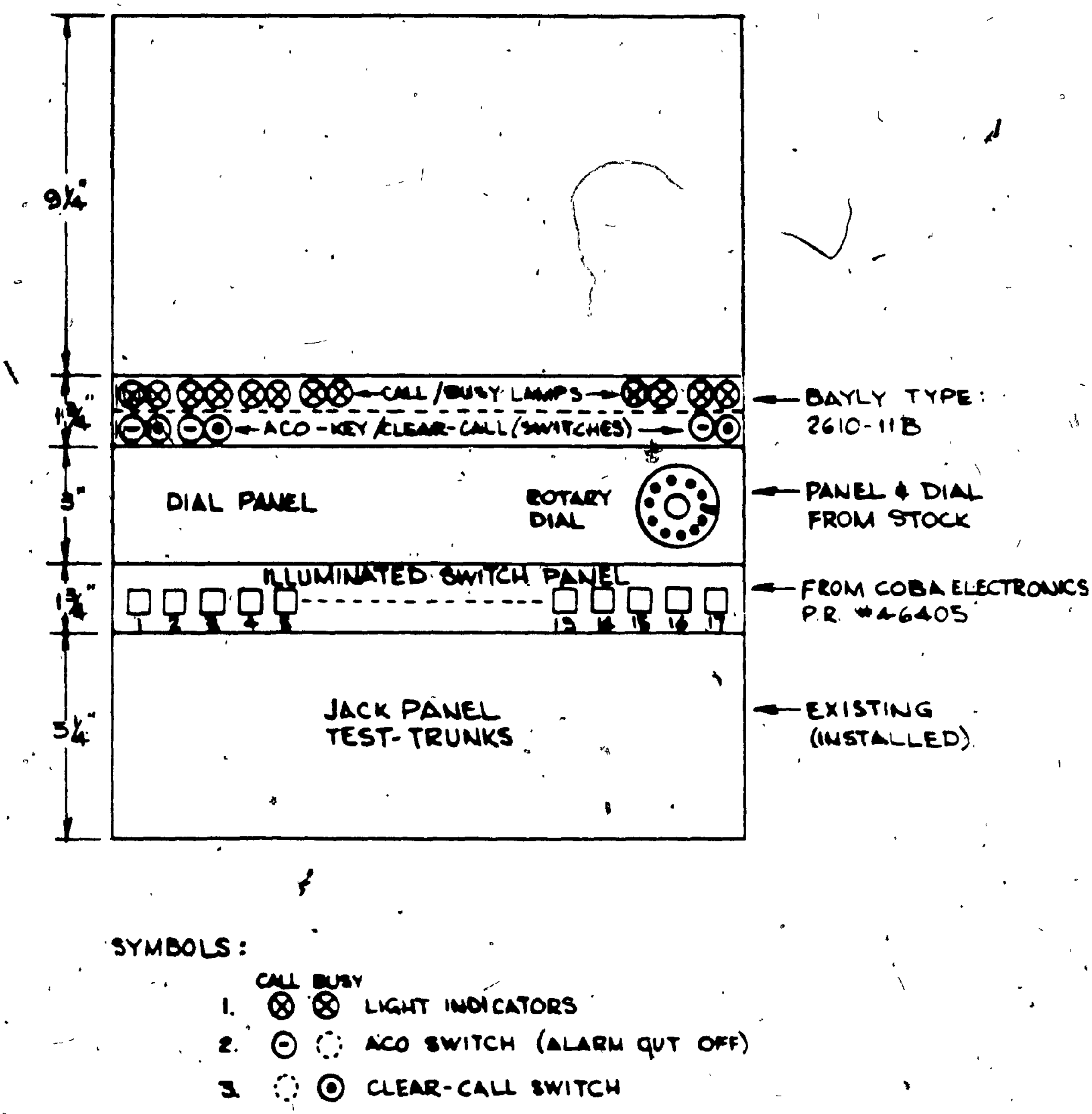


Fig. 4.28 — Trouble Report Point (TRP) Test Console Layout.

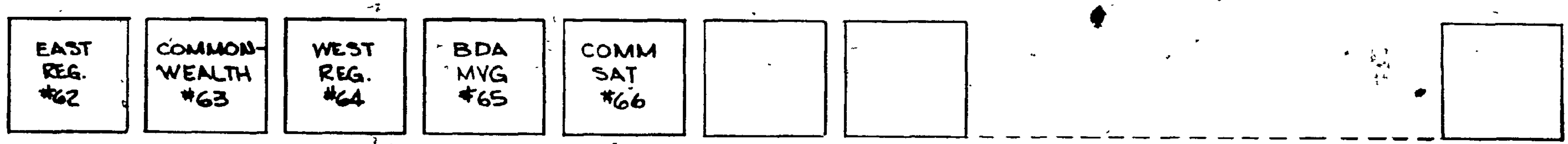


FIG. 1. SWITCH PANEL (FRONT VIEW)

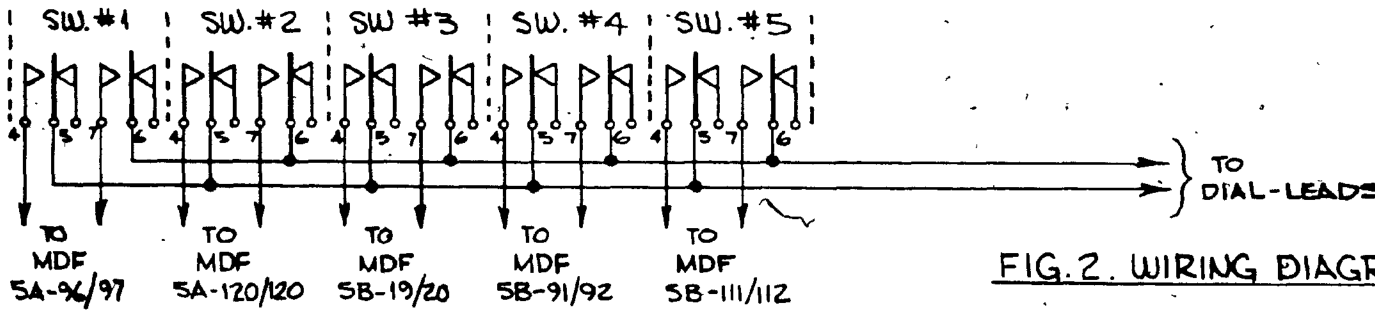


FIG. 2. WIRING DIAGRAM

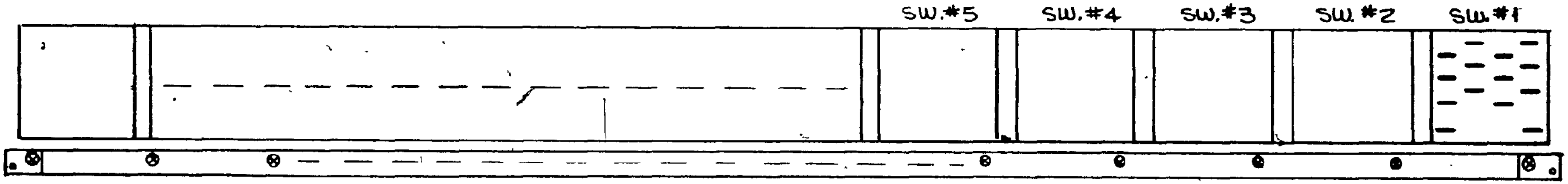


FIG. 3. SWITCH PANEL (REAR VIEW)

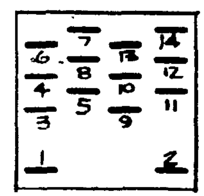
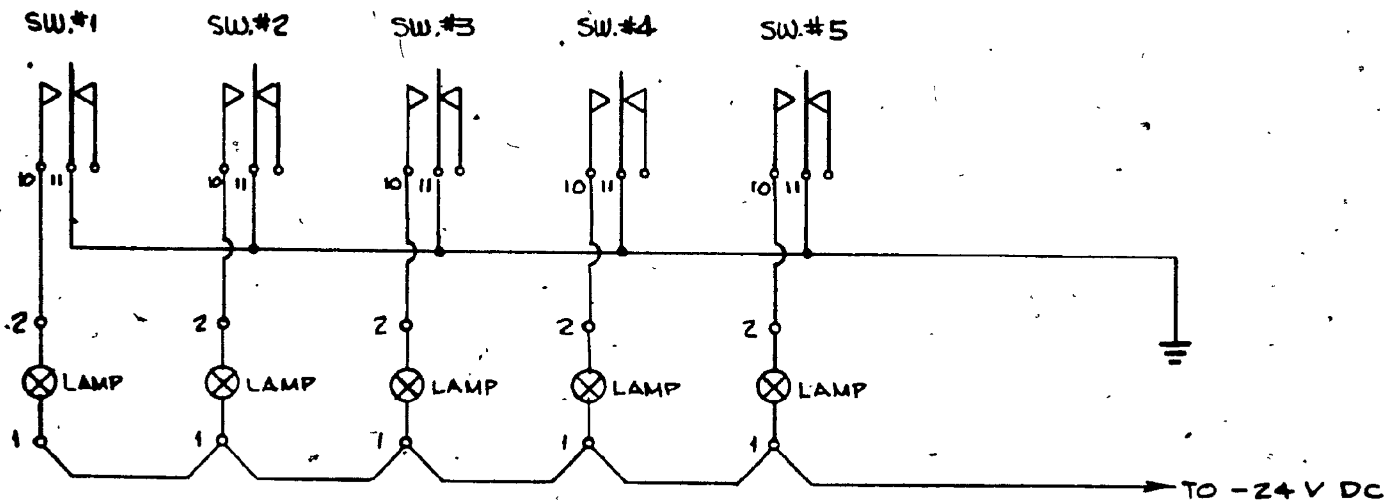


FIG. 4.

Notes:
1. Fig. 1 shows switch identification and assignment.
2. Fig. 2 shows wiring diagram for switch contacts and pin numbers.
3. Fig. 3 shows rear-view of switch-panel for reference and position.
4. Fig. 4 shows rear-view of switch and pin identification.
5. Connect pin #1 of all switches to -24VDC as in pg. 2 of this sketch.

Fig. 4.29 — Order Wire Dial Switches Wiring Information.



Notes:
1. Jumper pin #1 of all switches together and connect -24 V_{DC} as shown above.
2. Jumper pin #11 of all switches together and connect to ground as shown above.
3. On each switch connect pin #10 with pin #2 as above.
4. The lamps are already in place (in the switch).
5. For the pin numbers see Fig. 4 of this sketch on pg. 1.

Fig. 4.29 (cont'd) — Order Wire Dial Switches Wiring Information.

REF. TO Fig. 4.33

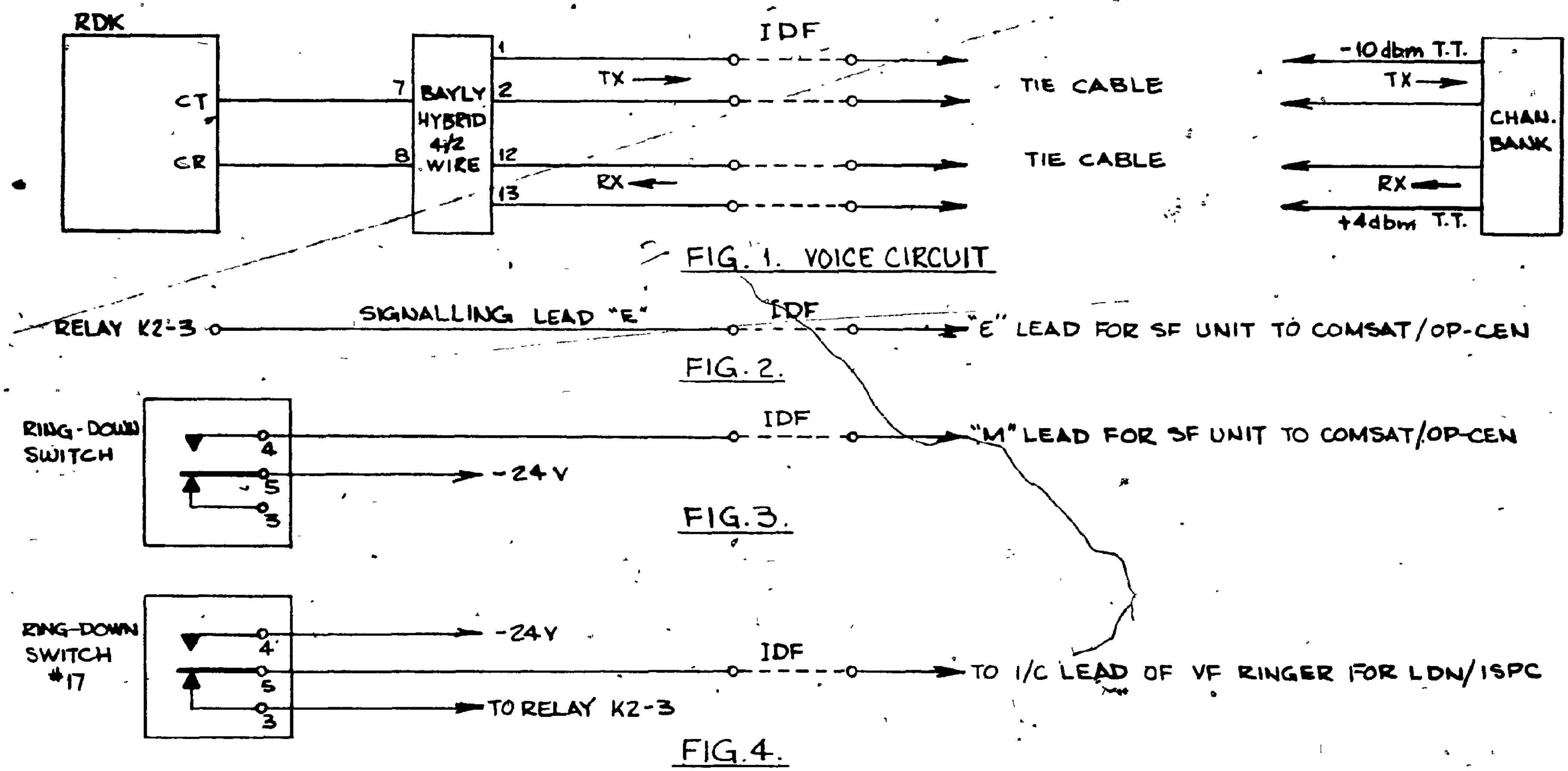
1)	Wire	from	SW1	PIN #4	to	MDF	5A/96	Via	IDF	V7-4/9a
2)	"	"	"	PIN #7	"	MDF	5A/97	"	"	V7-4/9b
3)	"	"	SW2	PIN #4	"	MDF	5A/120	"	"	V7-4/9c
4)	"	"	"	PIN #7	"	MDF	5A/121	"	"	V7-4/9d
5)	"	"	SW3	PIN #4	"	MDF	5B/19	"	"	V7-4/9e
6)	"	"	"	PIN #7	"	MDF	5B/20	"	"	V7-4/9f
7)	"	"	SW4	PIN #4	"	MDF	5B/91	"	"	V7-4/9g
8)	"	"	"	PIN #7	"	MDF	5B/92	"	"	V7-4/9h
9)	"	"	SW5	PIN #4	"	MDF	5B/111	"	"	V7-4/10a
10)	"	"	"	PIN #7	"	MDF	5B/112	"	"	V7-4/10b

Fig. 4.29 (cont'd) — Order Wire Dial Switches Wiring Information.

Consequently, it an ISPC operator wanted to call via an order wire, it was necessary to call the TRP operator and ask for the desired distant station. The TRP operator was in turn calling the corresponding RDK from the PABX console and then proceeded with the order wire signalling either by a rotary dial especially provided on the panel for the "OMNI" type, or by the ring-down switch for the "Ring-down" type, of order wires.

Details of the control panel of the order wires mounted on the TRP console is shown in Fig. 4.28. Each order wire had two lamps; one call-lamp red colour, and one busy lamp green colour. It also had two switches with one "C" contact each; one for the alarm cut-off "ACO" and one for clearing the calls, the "CLEAR-CALL" switch.

Wiring details of these switches and lamps are shown on Fig. 4.29 page 1 - 3, as well as on Fig. 4.30, for the ring-down.



Notes: Fig. #1 is typical circuit for the voice circuit of all order wires.
Fig. 4 is only for the signalling circuit of the LDN/ISPC order wire.
Fig. 2 and Fig. 3 is the signalling circuit of the COMSAT/OP-CEN order wire.

Fig. 4.30 — Wiring of Control Leads for Ring-Down Order Wires.

4.2.8 Supervisory Control

The supervisory control was required for the 72 telephony traffic circuits which were routed via the ISPC consoles, as part of the back-up or stand-by channels to the system. Due to the fact that these circuits might be live and busy most of the time, supervisory control facilities were necessary to prevent unwarranted human interference to any working circuit.

The supervisory control panel for the outgoing trunks consists of one busy lamp green colour and one maintenance lamp red colour. When the channel is occupied with a telephony circuit the green is on and therefore it cannot be taken, until the users stop using it. In that case if needed an ISPC operator could press the maintenance key which puts the red lamp on and at the same time it reserves the channel idle as soon as it becomes free. When it becomes free the green lamp goes off. At that time the ISPC operator could use that particular channel for a program transmission.

These supervisory facilities were in service at the ITMC of the gateway terminal. It was only necessary to extend them to the ISPC area in the form of parallel circuit for dual appearance of the controls.

The voice part of the 72 telephony circuits was distributed to the ten ISPC consoles at random depending on their destination. The supervisory control panels though were mounted at the TRP console. When necessary the ISPC operator, had to walk a few feet to the TRP console, or call the TRP operator, in order to busy-out (reserve) the required channel.

4.2.9 Line Monitoring and Talking

The requirement of monitoring the transmission lines of program circuits was one of primary importance. Monitoring is an essential requirement, for line-up procedures, for quality of transmission, for identification of circuits, as well as for trouble shooting procedures.

Each ISPC operator therefore would require to have a very versatile and efficient monitoring facility, which would enable him/her to handle the necessary operational requirements, efficiently. Another important factor for this requirement was the fact that each operator would have to handle numerous simultaneous program transmissions, for many different routes and with various speech characteristics.

The system, therefore, was equipped with a monitoring network designed to provide monitoring capability, either through a speaker or through a headset. Furthermore a special circuit arrangement was featured whereby the operator could monitor and talk into a channel if and when necessary.

The monitor amplifier used was the BAYLY Engineering Type PDA-8 (Dwg. #B-4725-4) mounted on the 19" x 1 3/4" panel of Bay "A" on each console. The INPUT to the monitor amplifier was wired to tip and ring of jack #96 of the auxiliary jacks or test panel via terminal block TB1 of each console as shown in Fig. 4.12 and Fig. 4.13. The output of the monitor amplifier is also wired through TB1 to tip and ring of jack #95 and thereafter to the 16 ohms monitor speaker via the spring contacts of the jack. In this configuration the operator could silence the speaker by inserting a dummy plug into jack #95. That was supposed to be done if and when it was required to monitor by the headset, and not by the speaker. Monitoring with the headset was accomplished by plugging it into jack #87 and #88. The tip and ring of these two headset jacks was wired directly to the headset monitor output of the amplifier that is Pin #P1-10 and P1-20.

The feature of monitoring and talking into a channel was made possible as follows:

With reference to Fig. 4.22, the PYLON telephone set, which was used to access the international telephone network, was wired to the two wire side of the hybrid. The four wire side of the hybrid was wired to a set of unidirectional amplifiers and then to the ECHO-supressor. Between the Echo-supressor and the terminals of the FIR, the receive path of the circuit was interconnected to tip-normal and ring-normal of jack #86 of the test panel and the transmit path was interconnected to tip-normal and ring-normal of jack #85 of the same panel. The signalling leads of the hybrid, pin #10 and pin #9, were interconnected to the E and M leads of the FIR through a transfer key mounted at the position of jack #84 of the test panel, as shown in Fig. 4.13. The transfer key was wired in such a way that at normal position the signalling leads of the hybrid were in continuity with the E & M leads of the FIR, but when turned 90° clockwise the E and M leads were disconnected and a stand-by talk battery of 24 V_{DC} could be connected to the head set, if its own power supply would have failed. The main purpose of the transfer key was to cut off the FIR from the Pylon set.

To monitor and talk into a channel therefore the following steps were necessary:

a) Turn 90° clockwise the transfer key located at the position of jack #84, to cut-off FIR.

b) Plug one end of a 4-conductor patch cord to jack #85 (Tx) and jack #86 (Rx).

c) Plug the other end of the same patch cord to the jacks which carry the channel to be monitored.

d) The transmit side of the channel must be patched to jack #85 and the receive side of the channel must be patched to jack #86.

e) Ready to monitor both sides of the channel and talk to the distant end at the same time, through the head-set of the pylon set.

f) When finished disconnect patch cord from both sides and turn transfer key in the C.C.W. direction back to its normal position.

4.2.10 The MIB Technique

For wide band program transmission, the circuit from ORTO was fed to the translating equipment via the music in band (MIB) equipment.

In effect the MIB is a piece of equipment by which a wide band program was fed to a two or three channel space in a group. The modules were removed and the MIB was injected with a patch-cord.

A total of 14 MIB circuits were provided for the ISPC and they were terminated on jackfield "C" of the consoles as required.

4.2.11 The Trouble Report Point Facilities

The trouble report point (TRP) was located in the ISPC area as shown in Fig. 4.2 . The equipment required for the trouble reporting operations were mounted on two consoles. The two consoles were made to provide 21" of rack mounting space each in the front, as well as a 9 1/2" of an inclined panel, between the writing desk and the main console. The consoles were also made to provide a 60-inch long table when mounted side by side as shown in Fig. 4.31 and Fig. 4. 32.

The TRP consoles were made with sufficient writing desk for two operators and with 60 inches of table which was used as a bench for some heavy bench-mounted test equipment.

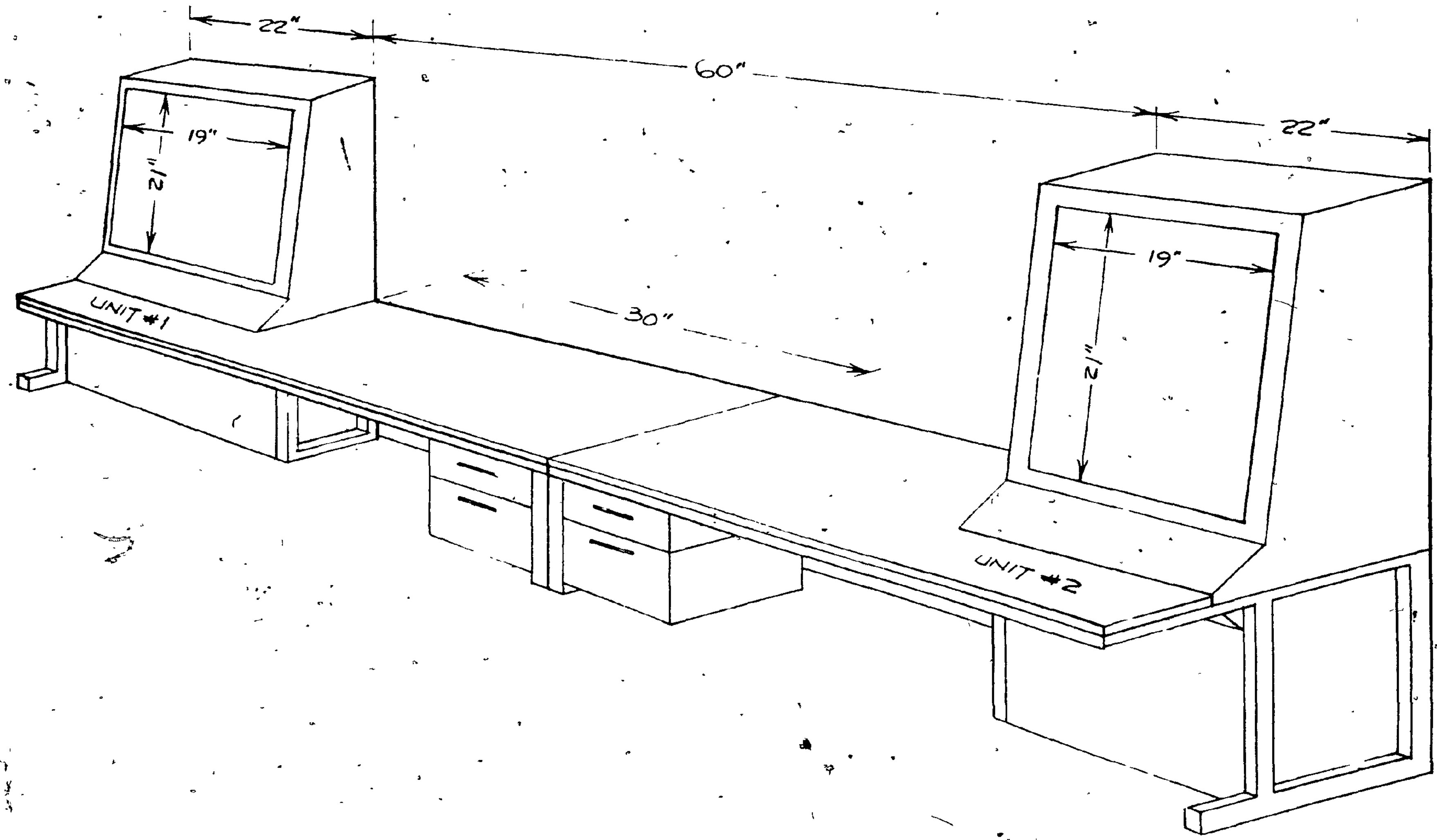


Fig. 4.31

ASSEMBLED VIEW OF MODIFIED PREMIER METAL MODEL 1407
WITH REQUIRED DIMENSIONS

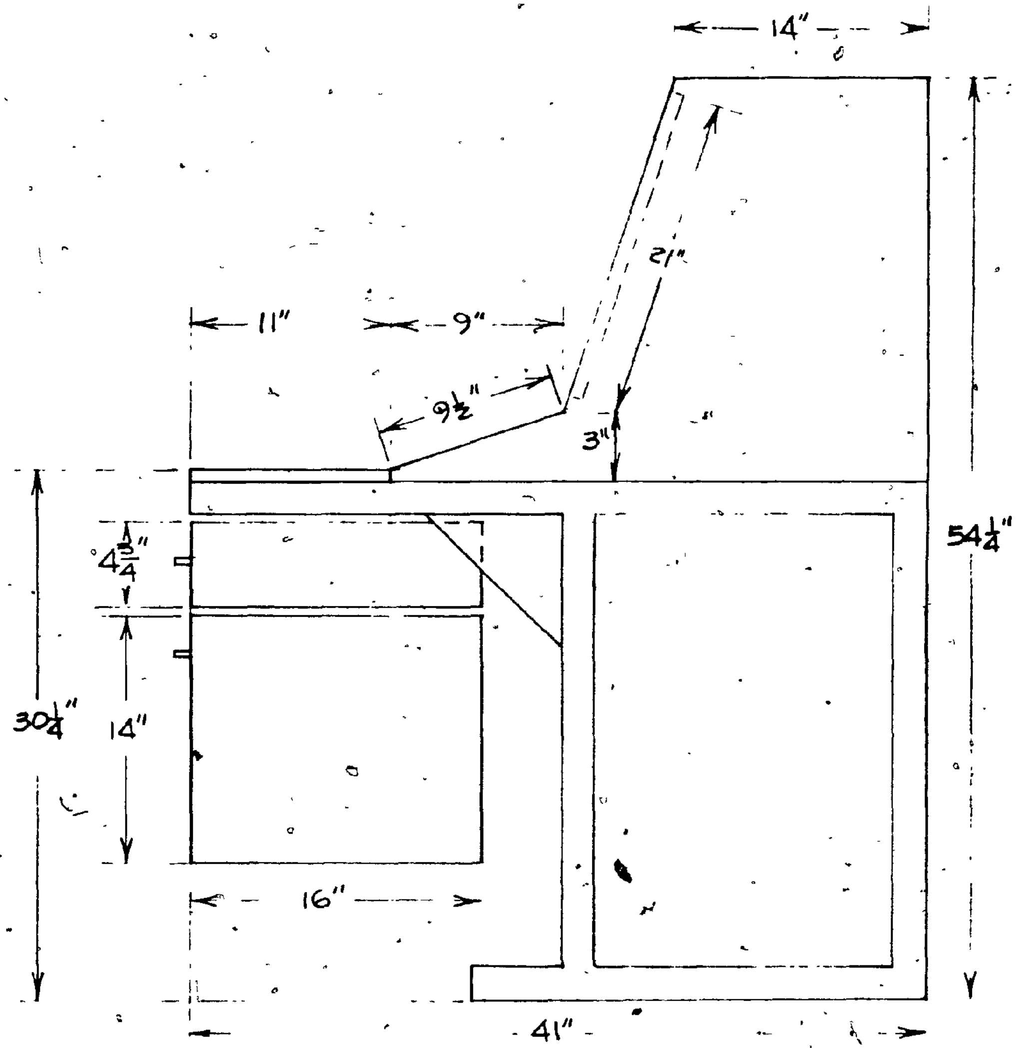


Fig. 4.32

SIDE VIEW OF MODIFIED PREMIER METAL MODEL 1407 WITH DIMENSIONS

The TRP was equipped to handle all types of fault reports from any point within our network facilities. The main equipment and facilities were:

a) Two PYLON telephone sets for international dialing.

b) A desk console of the PABX.

c) Control panel for all the order wires extended to ISPC.

d) Twenty test trunks between the ISPC and TRP, two per console, and 24 trunks to ITMC.

e) Two colour TV sets for video and audio-follow-video monitoring.

f) One distortion analyzer HP-334A (Panel-mounted).

g) One psophometer HP-3556A (bench-mounted).

h) One frequency and delay meter LDE-3 and LDS-3 (bench-mounted).

i) The supervisory control panel for 72 circuits which were routed via the ISPC consoles.

Monitoring facilities were not necessary. If any circuit had to be tested it was accessed via the trunk lines. For faults which were outside our network facilities the TRP operator was investigating the problem by contacting the Fault Report Center (FRP) of ORTO which was responsible for the overall Olympic network.

Chapter V

CONSTRUCTION OF THE SYSTEM BY PROCESS OF INSTALLATION INSTRUCTIONS

5.1 Partial Removal of IDF From TASI Room

I.I. #40/75, File No. BT-5/75/RS/2136

The scope of this Installation Instruction was to provide the necessary information to remove half of the existing IDF, from the TASI room. This was done in order to provide additional space for the ISPC room. The other half of the IDF was kept and used as the interface point between MDF and ISPC equipment. The vertical blocks necessary for the ISPC and the cable terminations on each block were shown in Fig. 5.1.

5.2 Relocation of Cabling Rack

I.I. #61/75, File # B-5/6/75/RS/2774

This Installation Instruction was issued to provide the information necessary for the relocation of a cabling rack from the TASI room to the ITMC area. The cabling rack which was 35 feet long and 2 feet wide, was redundant for the ISPC room. It was needed though at the ITMC area to accomodate the massive cabling required between the MDF and the IDF. The new overhead installation of the cabling rack was completed on time at the specified location, in order to facilitate cable routing from the MDF to ISPC.

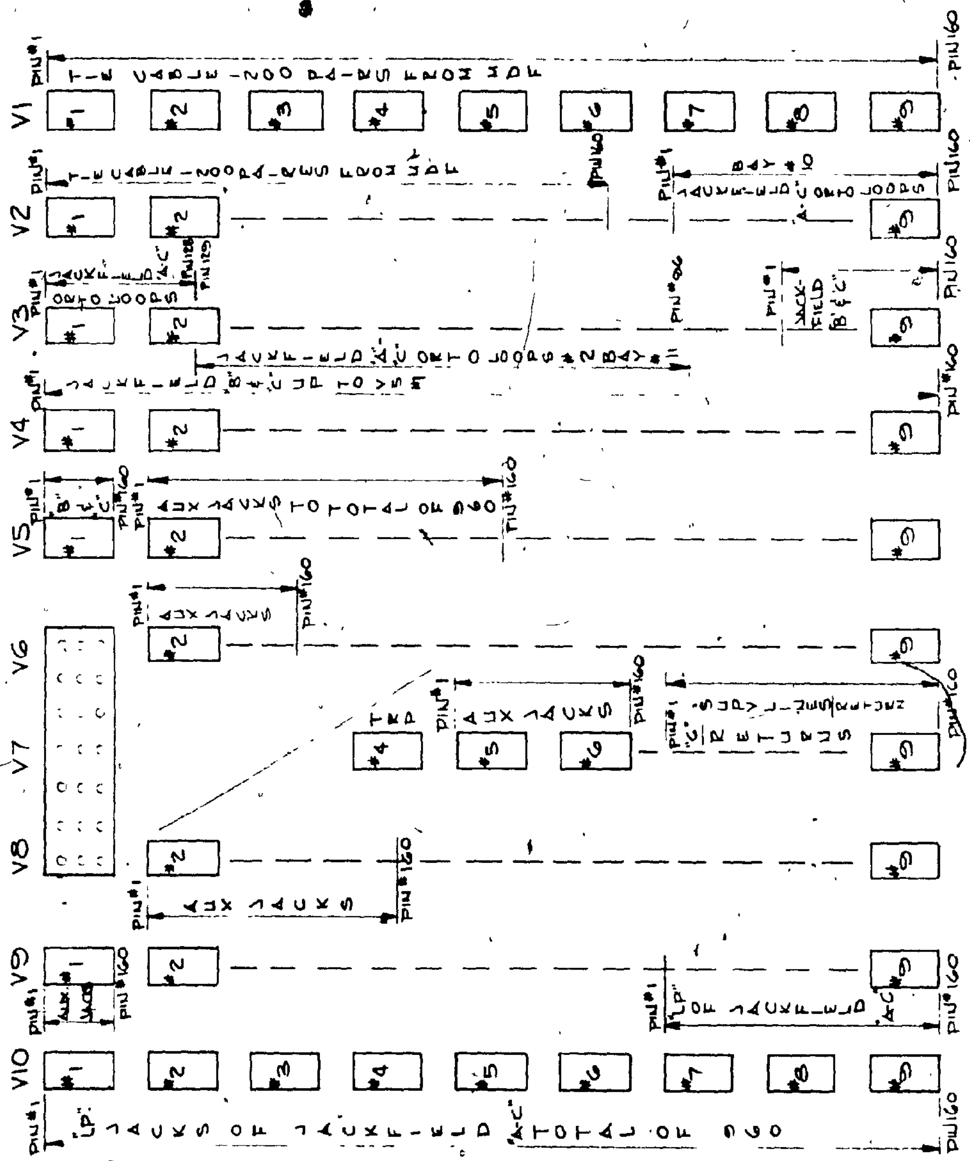


FIG. 5-1 - IDF VERTICAL & BLOCK IDENTIFICATION

5.3 INSTALLATION OF EQUIPMENT CABLES FROM MDF TO ISPC
I.I. # 66/75 File No. B-5/75/RS/3110

This installation instruction was issued to cover the information necessary to lay, install, and wire the tie cables between the MDF of the ITMC and the ISPC equipment in the former TASI room.

The total quantity of cable required for this instruction was approximately 11,000 feet of 60 pair cable 24 AWG, Northern Electric type 299A. That is 20 runs of cable, 250 feet per run, from the Bell-side of the MDF to the IDF blocks in the ISPC room, and 20 runs of cable 300 feet per run, from the console side of the IDF at the ISPC to the channel bank side of the MDF.

5.4 INSTALLATION OF JACKFIELD PANELS ON THE ISPC CONSOLE BAYS
I.I. # 73/75 File No. B-5/6/75/RS/3226

The scope of this instruction was to provide the necessary information for the installation of the jackfields required in the ISPC consoles.

The jackfields used, were taken from the old ITMC which was no longer in service. There was a quantity of 100 jackpanels available, equipped with long frame jacks, Northern Electric type 310-A. The required quantity for the ISPC was 92 jackpanels. That is, nine per console and two for the TRP.

This instruction was also covering the positioning and final assembly of the consoles in the lay-out and set-up form shown in Fig. 4.2 and Fig. 4.9 . Furthermore, it was specified how to identify the designation strips of the horizontal rows as of all the jackfields.

5.5 Wiring of the ISPC Circuit Jacks to IDF and MDF

I.I. # 75/75 File # B-5/6/75/RS/3335

This installation instruction details the information necessary to wire the jacks of the ISPC consoles to the IDF and MDF blocks. Included was also information regarding the interconsole jack-wiring.

This installation was split to three parts: part "A" was covering the wiring of the parallel-multiple interconsole loops of jackfield "A" using 100 pairs of 24 AWG cable. Part "B" was concerned with the wiring of the tip and ring of the jacks of jackfield "A-C" to the MDF cable, already installed under II#66/75 but not connected. Part "C" of this instruction was covering the wiring of jackfield "A", jackfield "B", jackfield "C" and "AUX. JACKS" test panel to the IDF, using 100 pairs of 24 AWG cable.

5.6 ISPC Supervisory Controls

I.I. #86/75 File No. B-5/6/75/RS/3631

This instruction was issued to document the installation of the supervisory control panels. A total of three panels Cantom type were installed at the TRP console with 24 circuits on each panel for a total of 72 circuits. The voice part of each circuit was passing through the ISPC consoles and the supervisory controls were extended to the TRP console from the switching.

5.7 Bell Coils Interconnection to the MDF

I.I. #100/75 File No. B-5/6/75/RS/3722

This installation instruction was containing the details and information necessary to wire the interconnection of the Bell coils on the M.D.F.

The coils were of the type QUK1A and they were provided by Bell. The interconnecting cable and information was also provided by Bell. These coils were provided by Bell as protective devices for their equipment.

5.8 JUMPERS BETWEEN BELL-CABLE (309-F) AND BELL-COILS (QUK1A) AT THE MDF. I.I. #115/75 File No. B-5/6/75/RS/3959

This installation instruction was a continuation of the one described in Section 5.7. After the coils were terminated to the MDF from both sides, jumper cross-connections had to follow in order to close the loop on both sides that is from the side of Bell Cable #309-F and from the side of the ISPC.

5.9 ISPC EQUIPMENT INSTALLATION AND WIRING I.I. #5/76 File No. B-5/6/76/RS/185

This instruction details the information necessary to install and wire the equipment and the auxiliary circuits required in the ISPC.

The major equipment requirements for this instruction were:

a) 10 VU-meters McCurdy type SA14021A. One per console.

b) 10 shelves 19" rack mount, equipped with:
- one distribution amplifier (BAYLY type PDA-8)
- one distribution network, BAYLY type Dwg #4897-4
- one monitor amplifier (PDA-8)
- one hybrid unit BAYLY type 4428C

c) 10 speaker assemblies.

d) 11 IDF terminal blocks for TB2, one per console and one for the TRP.

e) 10 balanced attenuators type 3983.

f) 12 PYLON telephone sets.

g) 1 test set HP-3550.

For efficiency this instruction was split into four parts. The first part was concerned with the equipment mounting. All the consoles were identical except the main console #9 which was equipped with extra equipment like the HP-3550 and the balanced attenuator pads.

Part "B" was concerned with the wiring of the equipment to the test panel jacks.

Part "C" was giving the details for the wiring of the monitoring facilities to the appropriate jacks of the test panel.

Part "D" was describing the details for the installation of the PYLON sets on the ten consoles, and their wiring to the hybrids via a terminal block.

5.10 PRIVATE LINE SERVICE INTERCONNECTION PYLON SETS

I.I. #16/76 File No. B-5/6/76/RS/298

This instruction is a continuation of the I.I. described in Section 5.9.

The scope of this instruction was to provide the details for the wiring interconnections of the special PYLON telephone sets to the international circuit. Since the sets were for 2-wire lines, we had to use the hybrids to convert them into four wire and consequently we had to use echo-suppressors on the line side.

In these lines we also used audio amplifiers Bayly Type #2835-A to compensate for losses. The echo suppressor was wired between the audio-amplifier and the FIR of each line.

5.11 TEST TONE DISTRIBUTION NETWORK FOR 1000 Hz AND 800 Hz

I.I. #28/76 File No. B-5/6/76/RS/636

The scope of this instruction was to document the necessary information for the installation and wiring of the two test-tone distribution networks.

Information and details of this I.I. have been discussed in section 4.2.5, which is the design of the test tone networks.

5.12 TIE-TRUNKS AND EQUIPMENT MOUNTING AT THE TRP OF THE ISPC

I.I. #41/76 File #B-5/6/76/RS/895

This instruction was issued in order to provide the necessary information for the installation and wiring of the equipment required at the TRP.

That is the test equipment outlined in section 4.2.11 and the tie trunks to each console.

5.13 ENGINEERING ORDER WIRE FACILITIES FOR THE ISPC

I.I. #53/76 File #B-5/6/76/RS/1302

The scope of this instruction was to cover all the necessary information required to install and wire the order wires, as explained in Section 4.2.7 of this paper. This installation had to be carried out in full coordination of activities with the branch personnel, because active circuits were involved.

5.14 RING DOWN ENGINEERING ORDER WIRES FOR THE ISPC

I.I. #60/76 File # B-5/6/76/RS/1470

This instruction was issued to provide the details for the installation and wiring of the RING-DOWN order wires which have also been discussed in Section 4.2.7 of this paper.

5.15 ACCEPTANCE TESTS OF THE ISPC FACILITIES
I.I. #48/76 File No. B-5/6/76/RS/11111

The scope of this instruction was to provide the information necessary to complete and verify all the installation works, as well as the acceptance tests for the ISPC facilities. Upon completion of the acceptance tests the system was turned over to the operations department for the training and later for the games.

5.16 BRIDGING FACILITIES FOR THE PORTABLE EARTH STATION FROM THE ISPC. I.I. #66/75 File #B-5/6/7/76/RS/1625

The scope of this last installation instruction was to provide all the necessary information to install and wire six high impedance bridging transformers for the monitoring extensions to the portable earth station from the ISPC.

The six high impedance matching transformers 40K/600Ω ohms, in series with six audio amplifiers BAYLY type 2835-A, made monitoring possible between ISPC and portable earth station.

CHAPTER VI

INTERNATIONAL SOUND-PROGRAM TRANSMISSION PROCEDURES

6.1 DEFINITIONS

6.1.1 International Sound Program Circuit

The unidirectional-transmission path between two I.S.P.C.'s.

6.1.2 International Sound Program Links

The unidirectional path for sound-program transmissions between the I.S.P.C.'s of the two terminal countries involved in an international sound-program transmission.

6.1.3 International Sound Progarm Connection

The unidirectional path between the broadcasting organization (send) and the broadcasting organization (receive) comprising the international sound program links extended at its two ends over national sound-program circuits to the broadcasting organizations.

6.1.4 Definition and Duration of the Line-Up Period and the Preparatory Period

a) Line-Up Period

Line up of international sound program links between Montreal ISPC and receiving ISPC before handover to ORTO and the receiving broadcasting administration.

Duration:	Simple links	-	15 minutes
	Complex links and multiple destinations	-	30 minutes

b) Preparatory Period

At commencement of this period the link is handed over by Montreal ISPC and receiving ISPC to ORTO and the receiving broadcasting administration.

Commencement of chargeable time.

6.1.5 Monitoring for Charging Purposes, Clearing Down

The monitoring of an international sound program transmission for charging purposes is carried out at the terminal I.S.P.C. of the international sound program link.

The I.S.P.C. should be aware of the following information.

a) the time of handing over the sound program links to the braodcasting organizations (beginning of chargeable period).

b) the time at which the sound program link is released by the broadcasting organizations (end of chargeable period).

c) where appropriate, the times and duration of every interruption or incident which may have occurred (in order to allow the operating services to determine whether a rebate is due, and if so, its amount).

6.2 SOUND-PROGRAM CIRCUITS, LINKS AND CONNECTIONS

6.2.1 Introduction

This instruction describes the line-up procedures and objectives for international sound-program circuits, links and connections.

Other instructions in the TT series give information on Facility Control and Maintenance.

The tests and objectives are based on the recommendations of the CCITT. Departures from the CCITT are identified.

6.2.2 Preliminary Tests

Before commencing line up tests, it is essential that all "in station" equipment tests and adjustments are completed. Reference should be made to the equipment testing instructions.

6.2.3 Test Record Forms

Test results should be recorded on the Circuit Order Form 07.002.

6.2.4 Test Procedures - Parameters - Objectives

i) Procedures

Test tones are injected and measurements made at the ISPCS.

Instruction TT1-1 defines the constituent parts of an international sound-program connection.

ii) Parameters - Objectives
Sound Program Circuits and Links

a. Measurement of Received Level
Inject Frequency - Level

1. Frequency 800 Hz or 1000 Hz.

The frequency must be counted or from a known source.

2. Level -12 dbm0 ± 0.1 dB.

Receive Objective

As near as possible to the nominal value appropriate to the ISPC.

b. Loss-Frequency Response

Inject Frequencies - Level

a) Frequencies

Frequency Hz	Program circuit/link KHz				
	6.4	10	5 *	8 *	11 *
50	x	x	x	x	x
80	x	x	x	x	x
100	x	x	x	x	x
200	x	x	x	x	x
500	x	x	x	x	x
800	x	x	x	x	x
1000	x	x	x	x	x
2000	x	x	x	x	x
3200	x	x	x		
4000			x	x	x
5000	x	x	x		
6000		x		x	x
6400	x				
8000				x	x
8500		x			
9000					x
10000		x			
11000					x

The frequencies must be counted.

b) Level -12 dBm0 ± 0.1 dB.

Receive Objective

a) Limits for the Received Level relative to that at 800 Hz for a 10 KHz Sound-Program Circuit.

Frequency Range	Level
Below 50 Hz	Not greater than OdB; otherwise unspecified
50 - 100 Hz	+1.4 to -0.6 dB
100 - 200 Hz	+0.9 to -0.6 dB
200 Hz to 6 KHz	+0.6 to -0.6 dB
6 to 8.5 KHz	+0.9 to -0.6 dB
8.5 to 10 KHz	+1.4 to -0.6 dB
Above 10 KHz	Not greater than OdB; otherwise unspecified

b) Limits for the Received Level relative to that at 800 Hz for a 6.4 KHz Sound-Program Circuit.

Frequency Range	Level
Below 50 Hz	Not greater than OdB; otherwise unspecified
50 to 100 Hz	+1.4 to -0.6 dB
100 to 200 Hz	+0.9 to -0.6 dB
200 Hz to 5 KHz	+0.6 to -0.6 dB
5 to 6 KHz	+0.9 to -0.6 dB
6 to 6.4 KHz	+1.4 to -0.6 dB
Above 6.4 KHz	Not greater than OdB; otherwise unspecified

c) Limits for the Received Level Relative to that at 800 Hz for an International Sound-Program Link Established Wholly of 10 KHz Sound-Program Circuits.

Frequency Range	Level
Below 50 Hz	Not greater than OdB; otherwise unspecified
50 to 100 Hz	+4.2 to -1.8 dB
100 to 200 Hz	+2.7 to -1.8 dB
200 Hz to 6 KHz	+1.8 to -1.8 dB
6 to 8.5 KHz	+2.7 to -1.8 dB
8.5 to 10 KHz	+4.2 to -1.8 dB
Above 10 KHz	Not greater than OdB; otherwise unspecified

d) Limits for the Received Level Relative to that at 800 Hz for an International Sound-Program Link Established Wholly of 6.4 KHz Sound-Program Circuits.

Frequency Range	Level
Below 50 Hz	Not greater than OdB; otherwise unspecified
50 to 100 Hz	+4.2 to -1.8 dB
100 to 200 Hz	+2.7 to -1.8 dB
200 Hz to 5KHz	+1.8 to -1.8 dB
5 to 6 KHz	+2.7 to -1.8 dB
6 to 6.4 KHz	+4.2 to -1.8 dB
Above 6.4 KHz	Not greater than OdB, otherwise unspecified

e) * Limits for the Maximum Spread for a 5-, 8- or 11 KHz Sound Program Circuit or an International Sound-Program Link Established Wholly of 5-, 8- or 11 KHz Sound Program Circuits.

Frequency Range	Spread
50 to 200 Hz	1.5 dB
200 Hz to 4 KHz (5 KHz)	1.0 dB
200 Hz to 6 KHz (8 KHz)	1.0 dB
200 Hz to 9 KHz (11 KHz)	1.0 dB
4 to 5 KHz	1.5 dB
6 to 8 KHz	1.5 dB
9 to 11 KHz	1.5 dB

f) Limits for the Received Level Relative to that at 800 Hz for a 3- or 4-KHz Sound Program Circuit or an International Sound Program Link Established Wholly of 3- or 4-KHz Sound Program Circuits.

(As per TT2-6 Section 4.2.2).

* Not covered by CCITT Recommendations.

Equalizers should be adjusted to bring the curve within the limits for the links

c. Noise

At the transmit ISPC, terminate the circuit with its characteristic impedance. At the measuring ISPC, measure the noise unweighted and weighted.

For the weighted measurement use a sound program circuit psophometer.

Objectives

Circuit up to 2500 KM

Unweighted 31 mV. -28 dBMO

Weighted 3.1 mV - 48 dBMOp

at a zero relative level point

No objectives are available for circuits exceeding a length of 2500 Km.

d) Crosstalk. Go-to-return*

At the distant ISPC, terminate both directions of transmission of the same circuit with their characteristic impedances. At the measuring ISPC, apply a 800 Hz tone at a level of OdBMO at the transmit point. Measure the receive level of crosstalk at 800 Hz at the receive point using a level measuring instrument.

Objective

Signal to crosstalk ratio should not be worse than 74 dB.

* Not covered by CCITT Recommendations.

Sound Program Connections

There are no recommended limits for the sound-program connection, but Administrations should endeavour to provide national sound-program circuits to as high a standard as possible so that the loss/frequency distortion of the sound-program connection is not markedly more than that of the sound-program link.

6.2.5 Measurements to be Made During the Line Up Period Preceeding A Sound Program Transmission

The national sound-program circuits should be so adjusted that when they are connected to the international sound-program links, the level diagrams of the international sound-program circuits are respected.

International Sound-Program Link

The received level at the distant incoming terminal ISPC should be measured at the following frequencies for correct levels.

For links composed of 10 KHz circuits	50,800 and 10,000 Hz
For links composed of 6.4 KHz circuits	50,800 and 6,400 Hz
For links composed of 5-, 8- or 11 KHz circuits	50,800 and 5,000 OR 8,000 or 11,000 Hz
For links composed of 3- or 4- KHz circuits	300, 800 and 3,050 or 3,400 Hz

The noise level should also be measured.

The CCITT does not specify limits for these measurements.

Any necessary adjustments having been made the national circuits are connected to the international sound-program link at the terminal ISPCs.

6.2.6 Measurements to be Made by the Broadcasting Organizations During the Preparatory Period

International Sound-Program Connection

The measurements by the Broadcasting Organizations should be limited to the following:

A check of the received level with a test tone of 800 or 1000 Hz at OdBMO at a zero relative level point. A test tone at this level must not be transmitted for more than 30 seconds. In the case of connections routed via CANTAT 2 this level should be reduced by 2 dB by inserting a pad at the transmit ISPC. At the receive ISPC the level should be increased by 2 dB.

- Where it is necessary to transmit test tones at 800 or 1000 Hz for longer than 30 seconds or when making measurements at other frequencies than the reference frequency then the transmit level must be at -12 dBMO at a zero relative level point.

6.2.7 Maximum Permissible Power During an International Sound-Program Transmission

Maximum level permitted on sound-program circuits

Peak power should not exceed + 9 dBm at a zero relative level point.

Maximum level permitted on an international telephone circuit used to carry a sound-program Transmission.

Peak power should not exceed +3 dBm at a zero relative level point. A 6 dB loss is introduced at the ISPC to meet this requirement.

CCITT References. No. N10-N13, N15, N21 and N22.

6.3 INTERNATIONAL CIRCUITS FOR PUBLIC TELEPHONY

6.3.1 Introduction

This instruction describes the line-up procedures and objectives for international circuits for public telephony.

Other instructions in the TT series give information on Facility Control and Maintenance.

The tests and objectives are based on the recommendations of the CCITT. Departures from the CCITT are identified.

6.3.2 Preliminary Tests

Before commencing line up tests, it is essential that all "in-station" equipment tests and adjustments are completed. Reference should be made to the equipment testing instructions.

Similarly the channel(s) making up the circuit should have been already lined up.

6.3.3 Test Record Forms

Test results should be recorded on the Circuit Order Form 07.002.

6.3.4 Test Procedures - Parameters - Objectives

A. Procedures

Reference should be made to TT2-1 where the procedure to be followed for lining up the constituent parts of the overall circuit is listed.

B. Parameters - Objectives

At the terminal stations of the overall circuit test tones are injected and measurements made at the "Circuit Access Points".

At the intermediate stations, measurements are made at the "Line Access Points".

Introduction TTl-1 defines the locations of these Access Points.

a. Overall Loss

Inject Frequency-Level

i) Frequency 800 Hz or 1000 Hz

The frequency must be co-nted or from a known source.

ii) Level -10dBm0 ± 0.1 dB

Receive Objective

As near as possible to nominal and not to exceed ± 0.3 dB.

The intermediate sub-control stations will measure the level of the test signal, and adjust it to the nominal value at the access points.

iii) Loss-Frequency Response

Inject Frequency-Level

a) Frequencies.

Chosen from the following list:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050, and 3400 Hz.

The frequencies must be counted.

b) Level. -10 dBm0 ± 0.1 dB

Receive Objective

Reference frequency 800 Hz.

a) Circuits and circuit sections using 4KHz spacing.

Frequency Hz	Between circuit access points Circuits/Circuit Sections dB.	At the access point at intermediate stations dB.
Below 300	Not less than 0.0 otherwise unspecified	Not less than -3.0 otherwise unspecified
300 - 400	+3.5 to -1.0	+9.0 to -3.0
400 - 600	+2.0 to -1.0	+6.0 to -3.0
600 - 2400	+1.0 to -1.0	+6.0 to -3.0
2400 - 3000	+2.0 to -1.0	+6.0 to -3.0
3000 - 3400	+3.5 to -1.0	+9.0 to -3.0
Above 3400	Not less than 0.0 otherwise unspecified.	Not less than -3.0 otherwise unspecified

b) Circuits and circuit sections using 3KHz spacing.

Frequency Hz	Between circuit access points Circuits/Circuit sections dB.	At the access point at intermediate stations dB
Below 200	Not less than 0.0 otherwise unspecified.	Not less than -1.5 otherwise unspecified
200 - 250	+10.5 to -0.5	Not less than -1.5 otherwise unspecified
250 - 300	+ 6.5 to -0.5	+9.0 to -1.5
300 - 2700	+ 1.0 to -0.5	+7.0 to -1.5
2700 - 2900	+ 2.5 to -0.5	+7.0 to -1.5
2900 - 3050	+ 6.5 to -0.5	+9.0 to -1.5
Above 3050	Not less than 0.0 otherwise unspecified.	Not less than -1.5 otherwise unspecified

c) Circuits and circuit sections using 3KHz and 4KHz spacing.

Frequency Hz	Between circuit access points Circuits/Circuit sections dB	At the access point at intermediate stations dB
Below 300	Not less than 0.0 otherwise unspecified.	Not less than -3.0 otherwise unspecified.
300 - 400	+3.5 to -1.0	+9.0 to -3.0
400 - 600	+2.0 to -1.0	+6.0 to -3.0
600 - 2400	+1.0 to -1.0	+6.0 to -3.0
2400 - 2700	+2.0 to -1.0	+6.0 to -3.0
2700 - 2900	+2.5 to -1.0	+9.0 to -3.0
2900 - 3050	+6.5 to -1.0	+9.0 to -3.0
Above 3050	Not less than 0.0 otherwise unspecified.	Not less than -3.0 otherwise unspecified.

The measurements at the Intermediate stations are taken during the overall circuit line up.

iv) Noise-Weighted

At the transmit station, terminate the circuit with its characteristic impedance at the circuit access point. At the measuring station, correct the psophometer to the circuit access point and measure and record the weighted receive noise level.

Objectives

Dist. km:	<320	321 - 640	641 - 1600	1601 - 2500	2501 - 5000	5001 - 10000	10001 - 20000
Noise dBmOp	-55	-53	-51	-49	-46	-43	-40

Satellite circuits contribute approximately -50dBmOp of noise and may be considered to be equivalent to 2500 Km.

v) Crosstalk. Go-To-Return

At the distant station, terminate both directions of transmission of the same circuit with their characteristic impedances at the circuit access points. At the measuring station, apply a 800 or 1000 Hz tone at a level of OdBmO at the transmit circuit access point. Measure the receive level of crosstalk at 800 or 1000 Hz at the receive circuit access point using a level measuring instrument.

Objective: Signal to crosstalk ratio should not be worse than 43dB.

vi) Check of Signalling Level

Measurements should be made to check the signalling levels at the transmitting end of the circuit.

Objective

Type of Signalling	Signalling Frequency: Nominal Value	Signalling Frequency: Tolerance	Absolute Power: Nominal value in dBm0 (tolerance 1 dB)
Manual	500 Hz interrupted at 20 Hz	±2%	uninterrupted (500 Hz) 0
		±2%	interrupted (500/200 Hz) -3
CCITT No. 5. Line Signals	2400 Hz	±6 Hz	-9
	2600 Hz	±6 Hz	-9
Register signals	700 Hz	±6 Hz	-7
	900 Hz	±6 Hz	-7
	1100 Hz	±6 Hz	-7
	1300 Hz	±6 Hz	-7
	1500 Hz	±6 Hz	-7
	1700 Hz	±6 Hz	-7

vii) Functional Tests

a) A check is made that signalling transmission over the circuit is satisfactory. Test calls should be made to the distant-end operators or technical staff to check the circuit both for signalling and transmission performance. These test calls check the echo suppressors for satisfactory working.

CCITT Reference. REC. M. 58.

S.C.T.T./C.O.T.C.

DEMANDE DE CIRCUIT/*CIRCUIT ORDER*

Entrée en service / *established* Jr/*Day*	Mo/*Mo*	An/*Yr*	Ident du circuit/*Circuit designation*
G M T HEURE *TIME*			Dem de circuit/*Circuit order*

1	Qualité téléphonique / *Voice grade*	Date d'échéance *Due date*	Jr/*Day* · Mo/*Mo* · An/*Yr*	
2	Contrôle/*Control*	Sous-contrôle/*Sub control*	Contrôle administratif/*Admin. ctl*	
3	Perte/*Loss* dB	4 Distance km	5 Signalisation/*Signalling*	
6	Fréquence d'essai/*Test freq.* KHz	7 Niveau de mesure/*Test level* dBmO	8 Limites par/*Limits per*	
9	Exigences spéciales/*Special requirements*			
10	I A L – Aut /*A.L.F. – Auth.*	11 E O I / *O.E.R*		

12	Voie/*Route*	Direction A-O	Niveau *Level*	Direction O A	Niveau *Level*	REMARQUES *REMARKS*
	A					
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					
	N					
	O					

13 RENDEMENT/*PERFORMANCE*

Att fréqu *Attn. freq* KHz	0 2	0 25	0 3	0 4	0 6	0 8	1 0	1 4	2 4	2 7	3 0	3 4
A *AT* dB												
A *AT* dB												

Divers *Misc* dBmO	Bruit pondéré *Weighted noise*	Bruit non pondéré *Flat noise*	Paradiaphonie *Ne XTalk*	Télédiaphonie *Fe XTalk*	Erreur de fréquence *Freq Error*	Date des essais *Date of tests* Jr/*Day* · Mo/*Mo* · An/*Yr*
A *AT*						
A *AT*						

14 DOSSIER / *HISTORY*

Emission no *Issue no*	REVISION	Emission no *Issue no.*	REVISION

15 DISTRIBUTION

- ☐ I T M C *C I M T*
- ☐ I S C C *C C S I*
- ☐ O P S *C.T.L*

6.4 TELEGLOBE - TROUBLE REPORTING PROCEDURES

6.4.1 Loss of Video or International Sound at Lake Cowichan

LAKE COWICHAN TRANSMIT ITC	TROUBLE REPORT CENTRE
1. Checks with BC Tel and Telesat and changes to standby line if required. Trouble handed to Telesat if in national section.	1. Receives report from LCN.
	2. Advises overseas ITCs.
	3. Advises OCC.
2. Advises TRC.	4. Receives reports from OCC.
3. Advices receiving earth stations.	5. Informs LCN and overseas ITCs of trouble clearance progress.
4. Receives reports from TRC.	
5. Trouble cleared, checks normal transmissions with receiving earth stations.	
6. Advises TRC.	6. Receives report from LCN
7. Receives outage times from TRC.	7. Agrees outage times with overseas ITCs.
	8. Advises LCN and OCC of outage times.

6.4.2 Loss of Video at Cote de Neiges

COTE DE NEIGES TRANSMIT ITC	TROUBLE REPORT CENTRE
1. Checks with OCC and changes to standby line if required.	
2. Advises Bell.	
3. Advises TRC.	1. Receives report from C de N.
4. Advises receiving earth stations.	2. Advises overseas ITCs.
	3. Advises OCC.
	4. Receives reports from OCC.
5. Receives reports from TRC.	5. Informs C de N. and overseas ITCs of trouble clearance progress.
6. Trouble cleared, checks normal transmission with receiving earth stations.	
7. Advises TRC.	6. Receives report from C de N.
	7. Agrees outage times with overseas ITCs.
8. Receives outage times from TRC.	8. Advises C de N and OCC of outage times.

6.4.3 Loss of Video at Mill Village

MILL VILLAGE TRANSMIT ITC	TROUBLE REPORT CENTRE
1. Checks with MTT.	
2. Advises TRC.	1. Receives report from MVG.
3. Advises receiving earth stations.	2. Advises overseas ITCs.
	3. Advises OCC.
	4. Receives reports from OCC.
4. Receives reports from TRC.	5. Informs MVG and overseas ITCs of trouble clearance progress.
5. Trouble cleared, checks normal transmission with receiving earth stations.	
6. Advises TRC.	6. Receives report from MVG.
	7. Agrees outage times with overseas ITCs.
7. Receives outage times from TRC.	8. Advises MVG and OCC of outage times.

6.4.4 Loss of Video or International Sound (West) on International Section (Earth Station --- Earth Station)

COTE DE NEIGES) LAKE COWICHAN) TRANSMIT ITCS MILL VILLAGE)	TROUBLE REPORT CENTRE
1. Receives report from receiving earth station(s).	
2. Advises TRC.	1. Receives report from transmitting earth station.
3. Receives reports from receiving earth station(s) of trouble clearance progress.	2. Confirms report with overseas ITCs.
	3. Advises OCC.
4. Advises TRC of reports.	4. Receives reports from transmitting earth station and advises OCC.
5. Trouble cleared, checks normal transmission with receiving earth stations.	
6. Advises TRC.	5. Receives report from transmitting earth station.
	6. Agrees outage times with overseas ITCs.
7. Receives outage times from TRC.	7. Advises transmitting earth station and OCC of outage times.

6.4.5 Loss of International Sound (East) or Audio on International Circuits

MONTREAL ISPC	TROUBLE REPORT CENTRE
	1. Receives report from Teleglobe stations or overseas ISPCs.
1. Receives report from TRC.	2. Advises ISPC.
2. Checks with ORTO and/or Teleglobe stations and/or overseas ISPCs. Changes to standby line as required.	3. Advises OCC.
3. Trouble cleared, checks normal transmission with overseas ISPCs.	
4. Advises TRC.	4. Receives report from ISPC.
	5. Agrees outage times with overseas ISPCs.
5. Receives outage times from TRC.	6. Advises ISPC and OCC of outage times.

6.4.6. Loss of Video or International Sound on Distant National Section (Earth Station-Receive ITC)

COTE DE NEIGES) LAKE COWICHAN) TRANSMIT ITCs MILL VILLAGE)	TROUBLE REPORT CENTRE
1. Receives reports from receiving earth station associated with distant national section.	1. Receives report from overseas ITC.
	2. Exchanges reports with transmitting earth stations.
	3. Advises OCC.
3. Receives reports from receiving earth station of trouble clearance progress.	4. Receives reports from overseas ITC of trouble clearance progress.
4. Exchanges reports with TRC.	5. Exchanges reports with transmitting earth station.
5. Trouble cleared, checks normal transmission with receiving earth station.	6. Advises OCC.
6. Advises TRC.	7. Receives report from transmitting earth station.
	8. Agrees outage times with overseas ITC.
7. Receives outage times from TRC.	9. Advises transmitting earth station and OCC of outage times.

CHAPTER VII

CONCLUSIONS

The objective of this Technical Report was to demonstrate how an International Sound Program Center was designed and developed, for a very important event with international significance and unpredictable risks.

The system's functioning and efficiency was remarkable. That, plus the fact that the system was never saturated leads one to the conclusion that the Olympic circuit requirements as well as the requirements for equipment and facilities were evaluated adequately.

The circuit arrangements discussed in Chapter IV, Section 4.2.3, in combination with the types of jackfields discussed in Section 4.2.4 have demonstrated that they provided the system with the maximum possible capacity. The test and other auxiliary facilities as well as the complete communications network, provided the system with a very high degree of efficiency and flexibility.

The technique utilized for the access of the order wires was remarkably successful, and it is recommended that it should be expanded to all the present facilities, especially since the voice station coupler has proven to be an ideal interfacing device.

Another major factor for the realization of such an efficient system was the provision of a separate Trouble Report Point (TRP) console, which was serving the overall facilities while at the same time, these facilities were accessible by any other ISPC operator.

The scheduling of the field works involved was also evenly distributed, and as a result the project was completed on time, with no sacrifice of time from other concurrent projects. Chapter V provides an insight of the order of priority by a short summary of each installation instruction.

Finally, the operational procedures for International Sound Program transmission, most of which are governed by the CCITT recommendations, are outlined in Chapter VI, including trouble reporting procedures. The contingency plans, although very carefully elaborated, were not included in this technical report because they are still considered classified for obvious reasons.

Appendix I

AVAILABLE DATA ON QCS2B - VOICE STATION COUPLER, By NEDCO

PART A

Northern Electric

QCS2B Voice Station Coupler

Many uses mean low inventory
The QCS2B Voice Station Coupler is a multi-use device designed to couple customer-provided equipment into a central office or branch exchange (PBX).

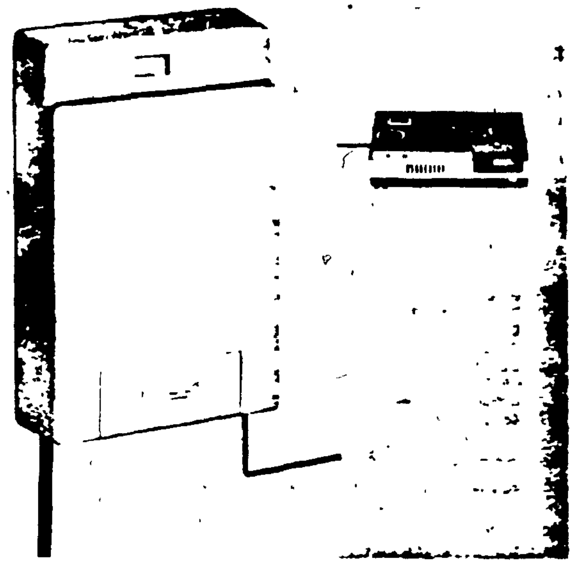
A large, expensive inventory would be needed to provide individual couplers for each of the innumerable makes and functions found in customer-provided equipment.

Because this coupler is so versatile, accepting over twenty Universal Service Order Code (USOC) arrangements, a large inventory of different couplers becomes unnecessary.

The major groups of functions accepted by this coupler are:

- Telephone answering machines
- Repertory diallers (auto dialling machines) used to monitor temperature or for burglar alarms. These can be fed back through an automatic dialler or be checked periodically.
- Alarm sending machines.
- Call extending equipment (Paging, intercom, etc.).
- Interface between customer's equipment or key telephone set
- Interface between central office and a loop-start PBX. Another feature is that when the coupler is used as a PBX or central office interface, only 2 wires are required, whereas other equipment requires 3 to 6 wires.

Quick and easy to change functions
You can easily set the coupler to interface with the required Universal Service Order Code (USOC) configuration within these groups, by making or breaking combinations of wire straps between terminals inside the coupler.



Voice coupler in use with a telephone answering machine — one of its more than twenty uses

It is this flexibility that leads, not only to low inventory, but to maximum usage of your stock of couplers. Suppose one of your customers stops using his coupler for telephone answering, then that same coupler could be removed and used for another customer with, perhaps, an alarm sending requirement. The change of usage is swiftly made by a simple re-arrangement of the wire straps.

To change usage, just re-arrange the wire straps

Northern Electric

QCS2B Voice Station Coupler

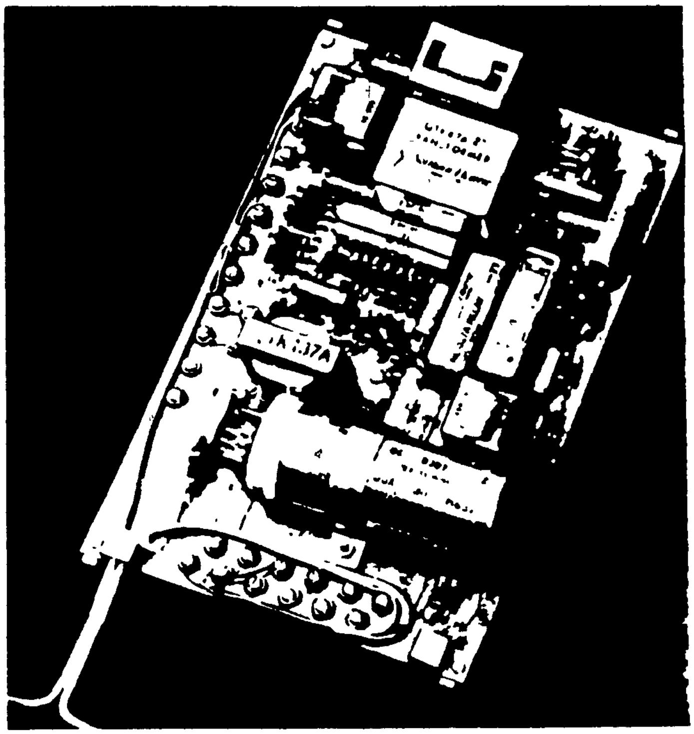
Easy installation and connection for yourself and your customer

Three keyhole slots in the back plate of the coupler permit easy vertical mounting on a wall near the customer's equipment.

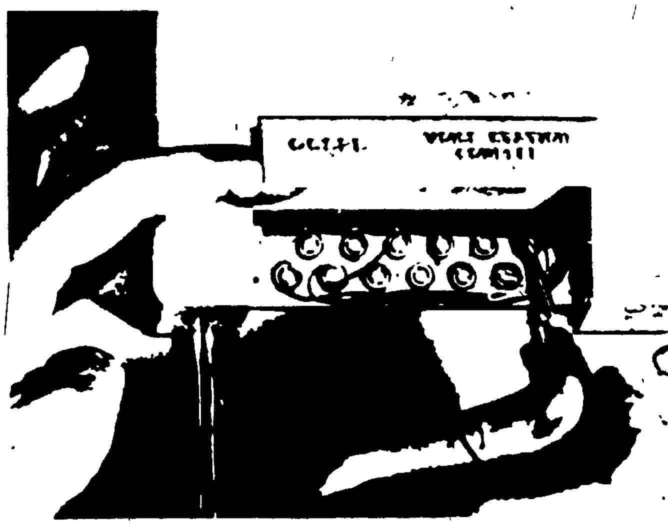
All external connections are made through simple screw terminals. This gives the coupler great flexibility for use in different applications, and also avoids the complication and inflexibility of multi-pin plugs and sockets or connector blocks.

When the cover is in place, the terminals associated with telephone company equipment are covered.

The terminals for connecting the customer's equipment are always accessible to the customer just by lifting the bottom flap on the cover. Protective circuits within the coupler, however, isolate and protect telephone company circuits from any improper connections that might occur at these terminals.



Simple screw terminals for easy connections. Easy wall mounting. Reliable components



Lift flap to connect customer's equipment

Northern Electric

QCS2B Voice Station Coupler

Lower service costs
It is seldom necessary to send your serviceman to investigate a service call involving customer's equipment, because the coupler contains circuitry that enables it to be tested remotely and also permits defective customer's equipment to be disconnected from central office.

Here's how it works —

• Remote test: the customer is asked to press the test button while central office applies test signals via the telephone lines.
The test button is marked TST and shows through a slot in the upper part of the cover. If successful, this test proves that the coupler is operating correctly, and shows that the customer's equipment is at fault. This operation hitherto required a service call and the use of special test equipment.

• Disconnection by the central office: you can disconnect defective customer's equipment by opening the central office loop for more than 3 seconds. Circuits within the coupler then transfer the connection to the customer's telephone set.

If a problem develops within the customer's equipment, the central office or PBX equipment is protected against hazardous voltages and excessive signal levels by limiter circuits in the coupler.


When TST button is pressed, remote tests can be performed

The electronic circuits within the coupler use highly-reliable solid-state and other components, so it is unlikely that you will experience service problems with the coupler itself.

Northern Electric

QCS2B Voice Station Coupler

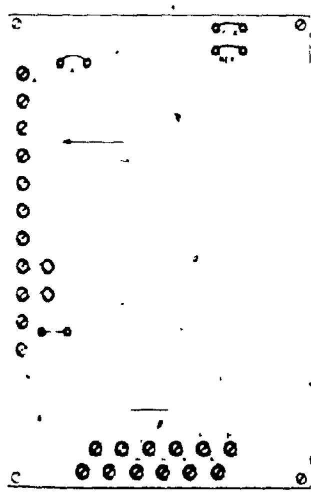
Technical information

Selection of USOC code arrangements

Strap connections inside coupler

Functional group	USOC code	TAM	RG1	REPD	RS-1 RS-4	RS-2 RS-3	CTR	Description
Telephone answering machines	RDMZR	√	X	√	X	X	X	Recorder service
	RDMZY	√	X	√	X	X	X	
	RDY	√	X	X	X	X	X	
	CD6	√	X	√	X	X	X	Incoming auto attendant
Repertory diallers	SU7OW	X	X	X	X	X	X	Dialler service
	SU7VW	X	X	X	X	X	X	
Alarm sending machines	SU6AQ	X	X	√	X	X	X	Without tones
	SU6AV	X	X	√	X	X	X	With tones
	STSOT	X	X	√	X	X	X	With tones
	STSVT	X	X	√	X	X	X	Without tones
Call extending eqpt	STCOX	X	X	X	√	√	√	
	STCVX	X	X	X	√	√	√	
Interface or key tel	1A (CDA)	√	X	√	X	X	X	2 Way manual
	3A (CDN)	√	X	√	X	X	X	2 Way manual
	CD4	√	X	√	X	X	X	2 Way manual
	CD5	√	X	√	X	X	X	2 Way manual
	C2ACP	X	X	√	X	X	X	Multi-lead without bell set
	C2AKS	X	X	√	X	X	X	Multi-lead with bell set
Interface central office — loop start PBX	CD7 8 9	X	X	√	X	X	√	Outgoing auto attendant
	*							Ringing on CT-CR
	*				X	X		20Hz (Special assembly) Ringing

√ = Strap in X = Strap cut * = In addition to any of the USOC codes



Terminal and strap locations

To set the coupler to any desired function, look at the table above, find the function and USOC code you require in the left hand columns. Next, set the wire strap connections as listed opposite the code. The figure shows you the locations of the straps under the coupler cover.

Northern Electric

QCS2B Voice Station Coupler

NE-2012B-49 transformer
Low-voltage power for the voice coupler is provided by the NE-2012B-49 transformer. It has two prong-type terminals which plug directly into a 105 to 125 volt, 50 or 60 Hz power outlet. Power consumption is 2 25 watts, maximum. Nominal output is 18 volts ac. Two recessed screw terminals are provided for load connections. The cover of the transformer is finished in light olive-grey to match the cover of the coupler. The NE-2012B transformer is not supplied with the coupler, and must be ordered separately.
(please see ORDERING INFORMATION).

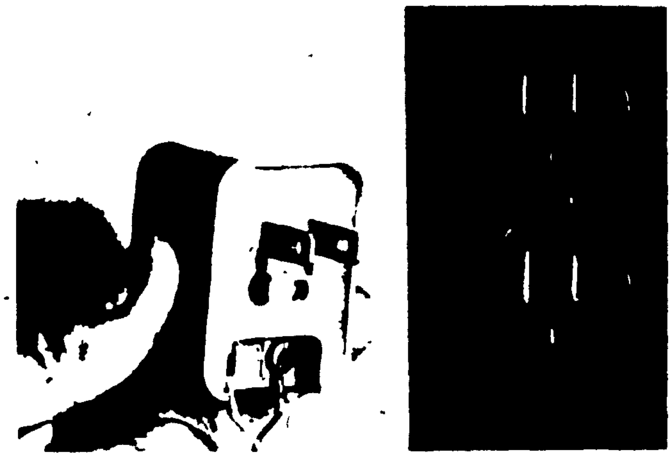
Voice transmission characteristics
The coupler provides transmission (terminals CT-CR) to and from the telephone line, with the following characteristics.

1 Attenuation Approximately 2 db or less when terminated with 600 ohms by the customer's equipment

2. Impedance: Impedance presented to the customer's equipment is 600 ohms resistive

3. Frequency range: 300 - 3000 Hz.

4. Speech amplitude limiting· Level received from the customer's equipment is transmitted to the telephone facilities at a maximum − 8dbm over any 3 second interval.



Physical characteristics
Dimensions 9 in. (229 mm) long x 6 in. (152.5 mm) wide x 2½ in. (63.5 mm) deep.
Weight 3 lbs. (1.36 kg)

Ordering information
When ordering please specify quantity, code number and name of product Product code numbers and correct names are as follows
QCS2B Voice Station Coupler.
NE-2012B Transformer.
Example:
Qty (specify) QCS2B Voice Station Coupler

Shipping information
Couplers are packed one to a carton.
Shipping carton dimensions
10¼ in. (260 mm) x 9¼ in. (232 mm) x 5½ in. (140 mm).
Shipping weight
Approximately 4 lbs. (1.8 kg).

PREVIOUSLY COPYRIGHTED MATERIAL

IN APPENDIX I, LEAVES 145-152

NOT MICROFILMED.

MAY BE OBTAINED FROM:

BAYLY ENGINEERING LIMITED
167 HUNT STREET
AJAX, ONTARIO
CANADA
L1S 1P6

REFERENCES

1. COMMUNICATION SYSTEM ENGINEERING HANDBOOK

   Donald H. Hamsher, Editor-in-chief
   U.S. Army Electronics Command
   1967 - Publication of McGraw-Hill Inc.

2. THE LENKURT DEMODULATOR

   (News from Lenkurt Electric)
   Volume 11, No. 11, November 1962
   Volume 13, No. 3, March 1964

3. MA-5A MULTIPLEX, Bulletin TB202

   Transmission Division
   Northern Electric Co. Ltd., Canada

4. TRANSMISSION SYSTEMS FOR COMMUNICATIONS

   Revised, fourth edition
   Bell Telephone Laboratories, Inc.

5. CARRIER AND RADIO ARTICLES FROM THE LENKURT DEMODULATOR

   Lenkurt Electric Co. Inc. - 1959

6. COMMUNICATION SYSTEMS DESIGN

   Line-of-sight and tropo-scatter systems
   by Philip F. Panter, Ph.D.
   ITT Aerospace/Optical Division
   1972 Publication by McGraw Hill Inc.

7. ELECTRONICS ENGINEERS HANDBOOK

   by Donald G. Fink, Editor-in-chief
   First edition, 1975 publication by McGraw-Hill Inc.

8. RADIOTRON DESIGNER's HANDBOOK
   by F. Langford-Smith
   Fourth edition. Published in 1952 by the Wireless Press for Amalgamated Wireless Valve Co. Pty. Ltd. and Radio Corporation of America.

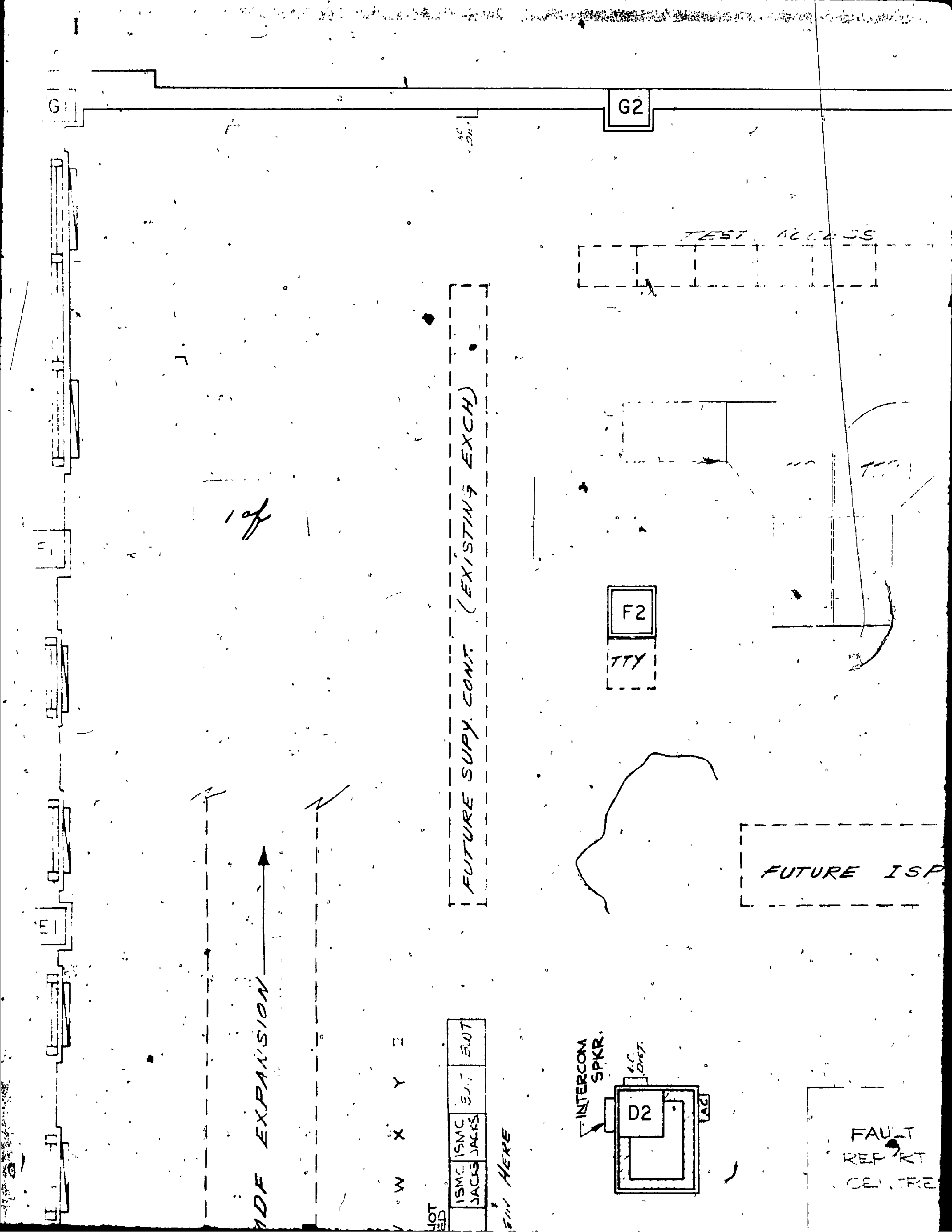
9. NETWORKS AND LINES

   Volume I
   by John Kaffetzakis
   Athens - 1961 Publication

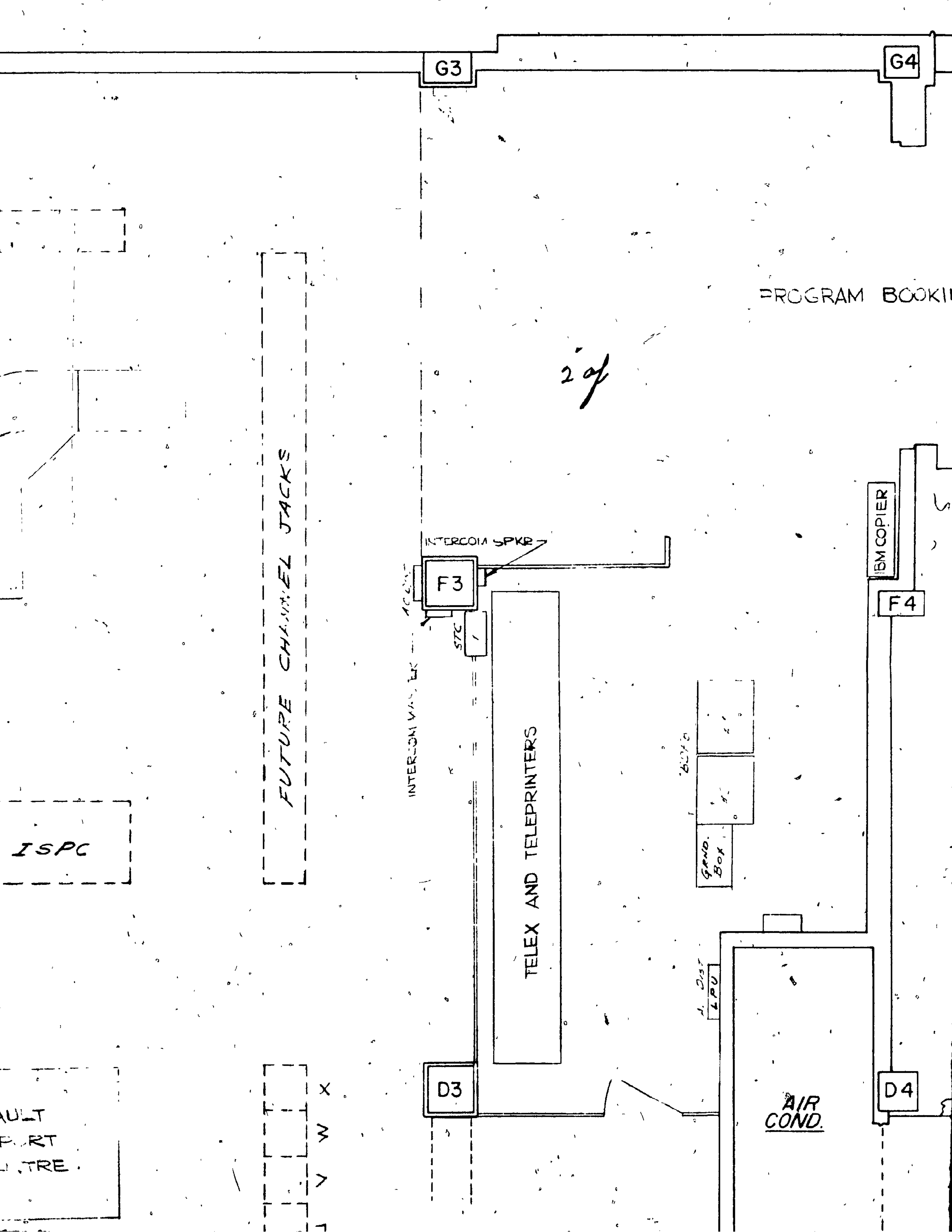
10. CCITT Fifth Plenary Assembly

Volume III-1 Green book, Line Transmission
Volume III-2 Green book, Line Transmission

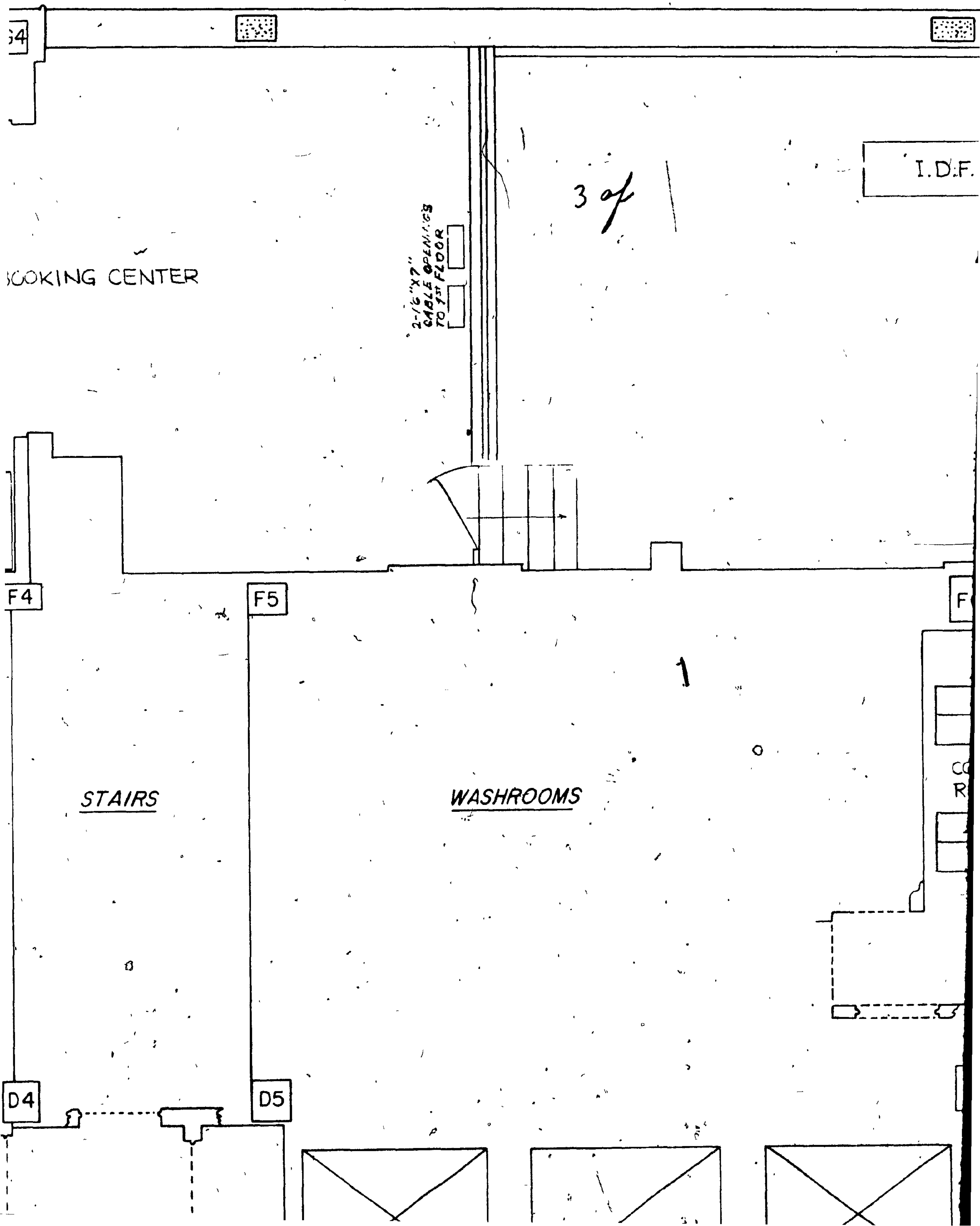
Geneva, 4-15 December 1972
Published by: The International Telecommunication Union (1973).



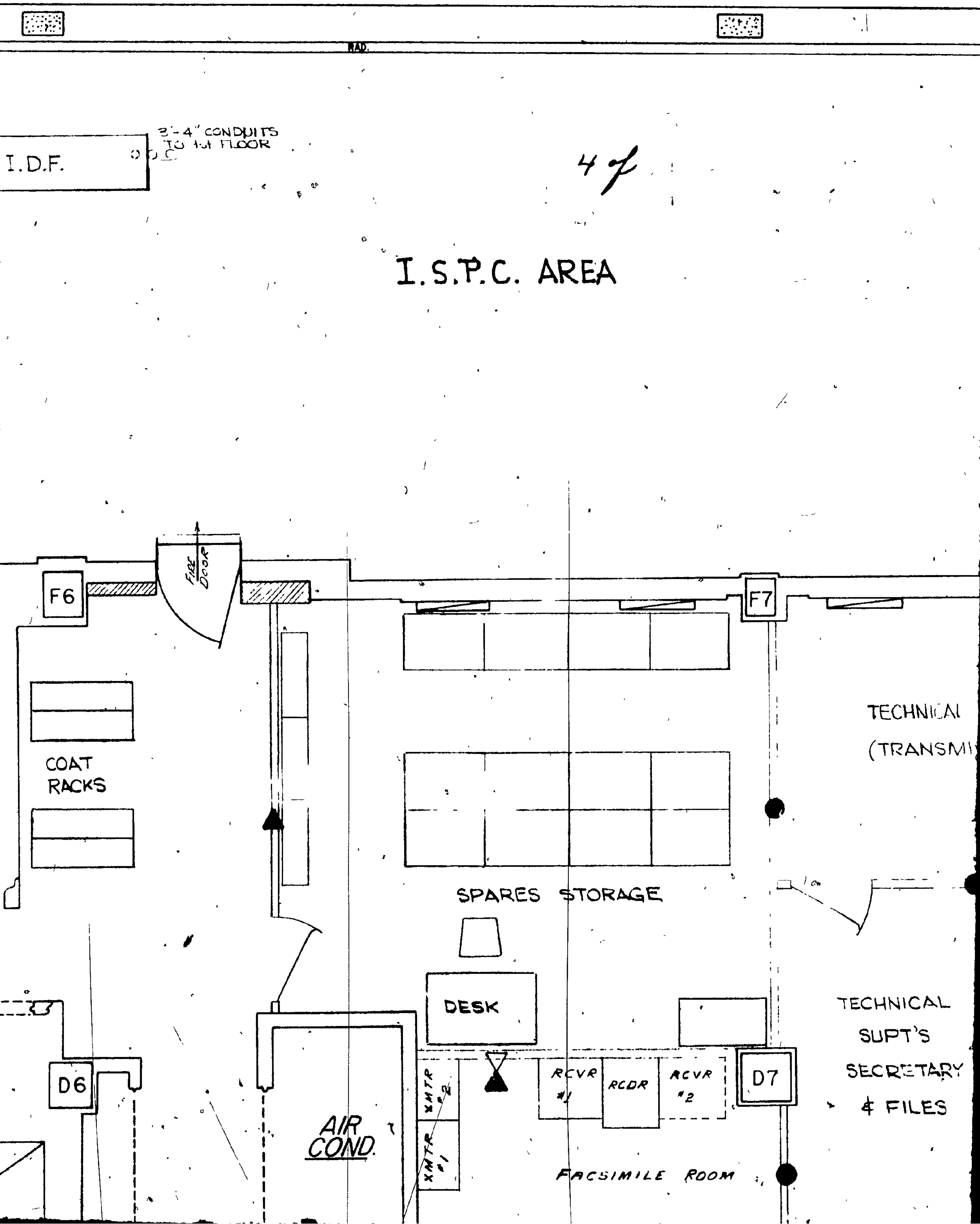
G1
G2
TEST
F2
TTY
FUTURE SUPY. CONT. (EXISTING EXCH)
1 of
EXPANSION
FUTURE ISP
INTERCOM SPKR.
D2
AC
ISMC JACKS
ISMC JACKS
W
X
Y
HERE



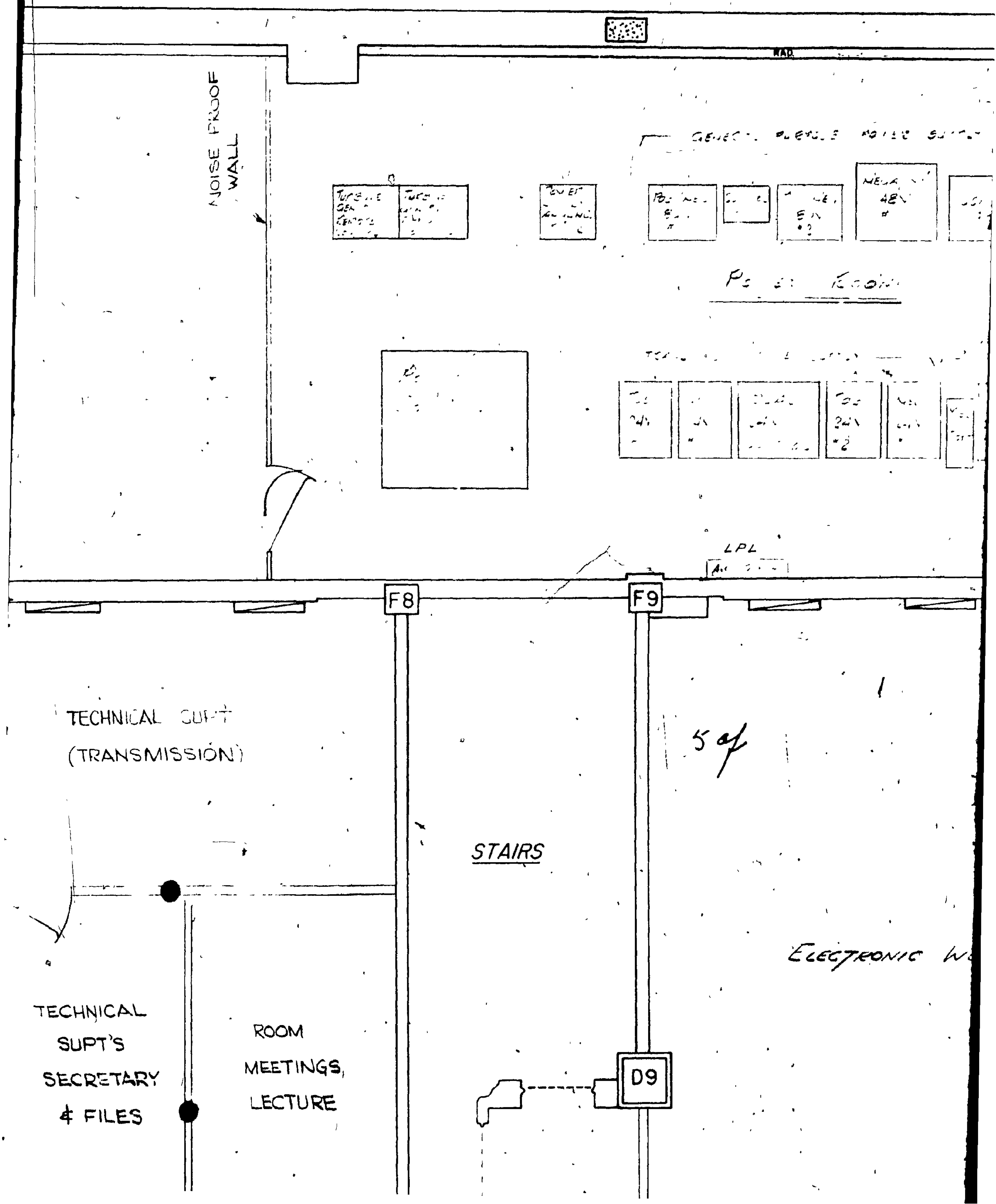
G3
G4
FUTURE CHANNEL JACKS
ISPC
INTERCOM SPKR
F3
STC
IBM COPIER
F4
TELEX AND TELEPRINTERS
GRND. BOX
LPU
AIR COND.
D3
D4
X
W
Y



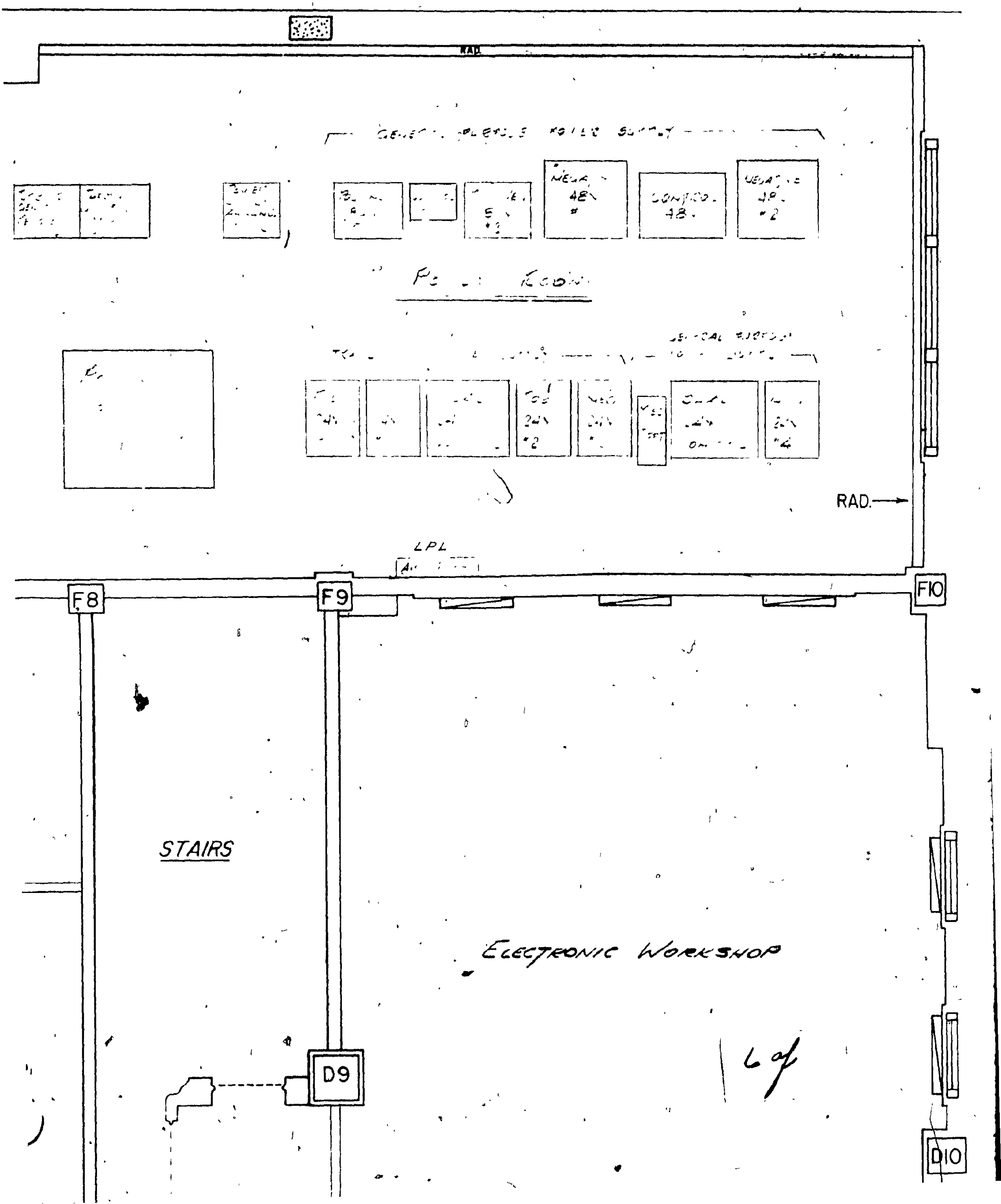
OOKING CENTER
2-1'6"x7" CABLE OPENINGS TO 1st FLOOR
3 of
I.D.F.
F4
F5
1
STAIRS
WASHROOMS
D4
D5



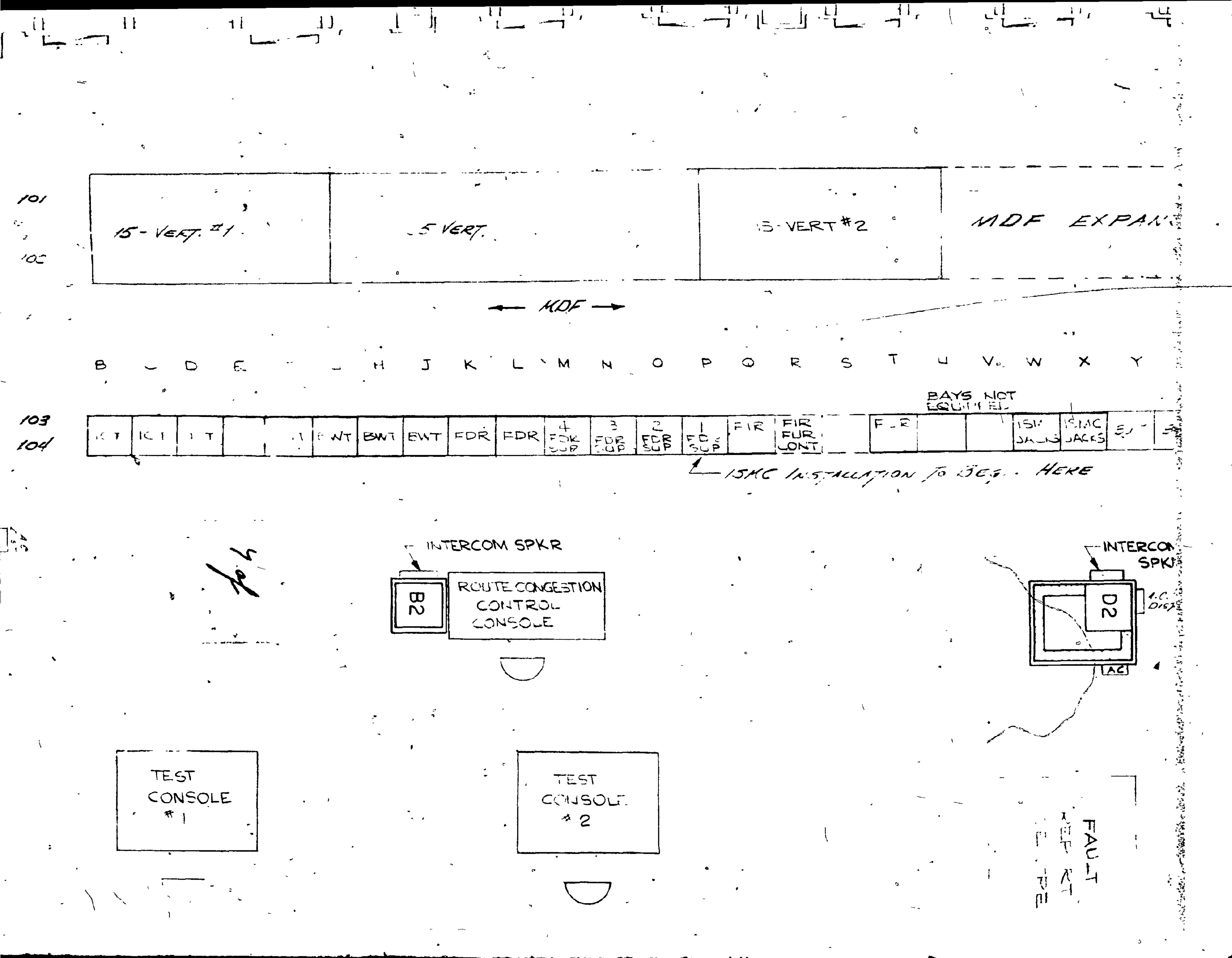
RAD.
I.D.F.
3-4" CONDUITS TO 1st FLOOR
47
I.S.P.C. AREA
F6
FIRE DOOR
F7
COAT RACKS
TECHNICAL (TRANSMI
SPARES STORAGE
DESK
D6
D7
RCVR #1
RCDR
RCVR #2
XMTR #2
XMTR #1
AIR COND.
TECHNICAL SUPT'S SECRETARY & FILES
FACSIMILE ROOM

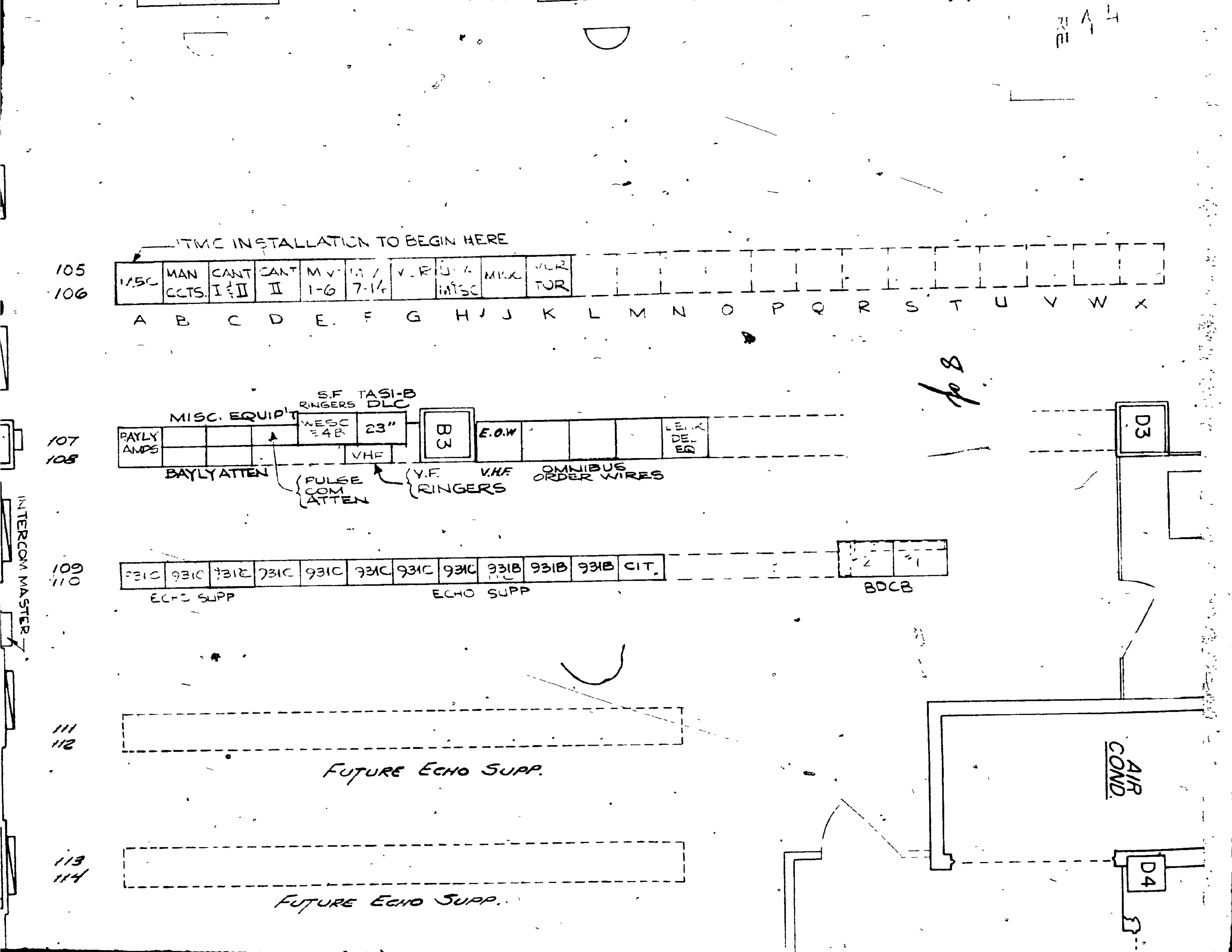


RAD.
NOISE PROOF WALL
LPL
F8
F9
TECHNICAL SUPT
(TRANSMISSION)
STAIRS
5 of
ELECTRONIC
TECHNICAL SUPT'S SECRETARY & FILES
ROOM MEETINGS, LECTURE
D9

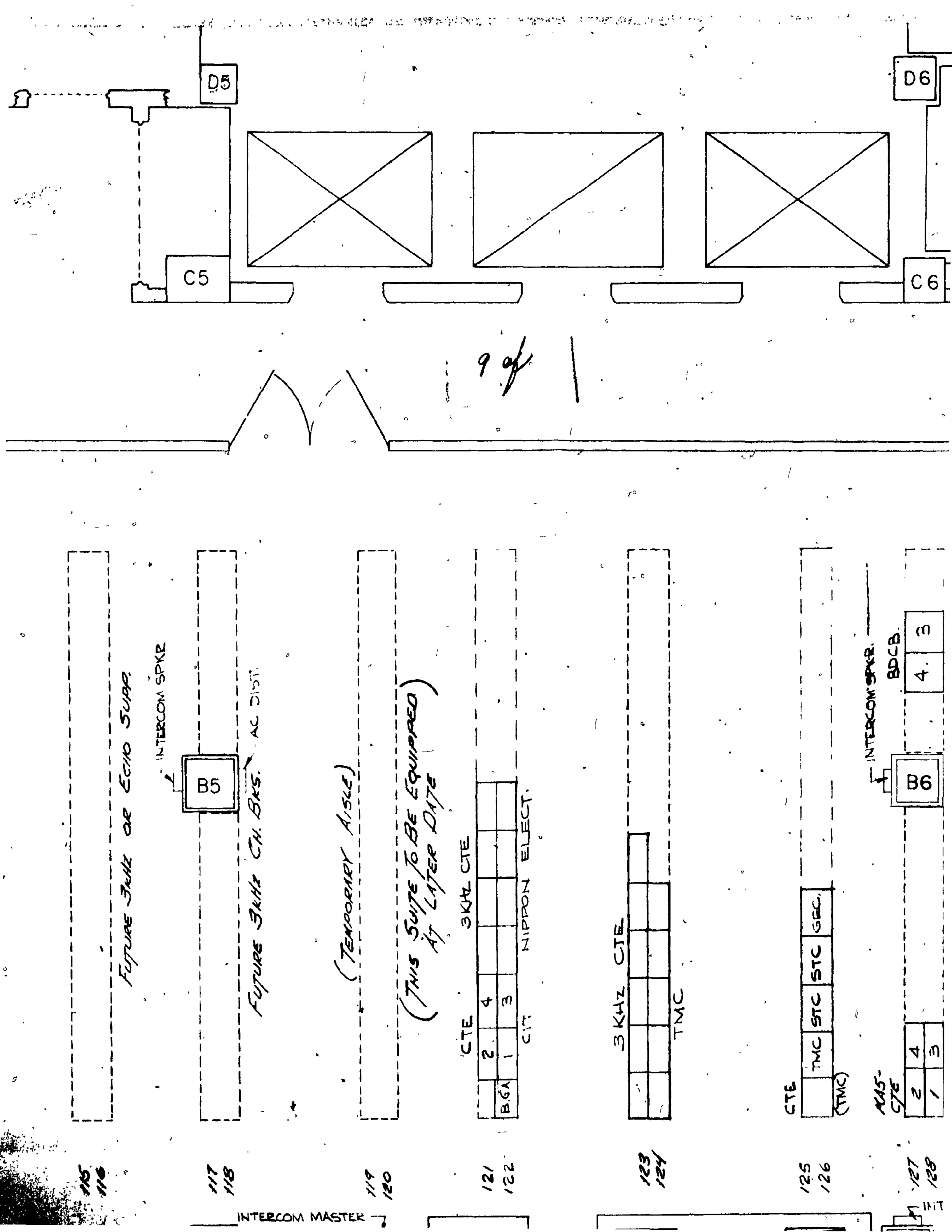


RAD.
CONTROL 48V
RAD.
LPL
F8
F9
F10
STAIRS
ELECTRONIC WORKSHOP
D9
6 of
D10

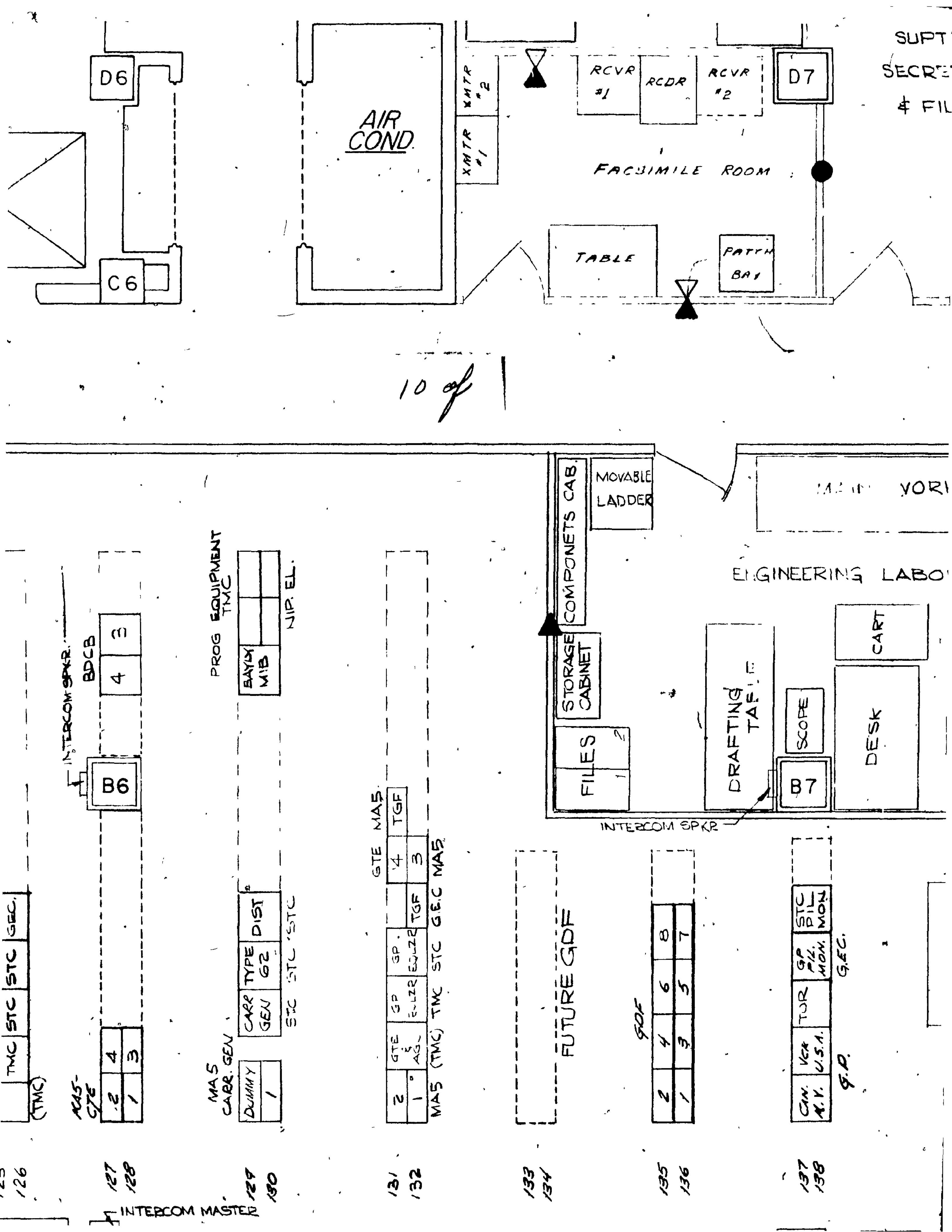

101
102
15 - VERT. #1
5 VERT.
15 VERT #2
MDF EXPAN
MDF
B D E H J K L M N O P Q R S T U V W X Y
BAYS NOT EQUIPPED
103
104
BWT
EWT
FDR
FDR
4 FDR SUP
3 FDR SUP
2 FDR SUP
1 FDR SUP
FIR
FIR FUR CONT
ISM JACKS
ISMC JACKS
ISMC INSTALLATION TO BEG. HERE
INTERCOM SPKR
B2
ROUTE CONGESTION CONTROL CONSOLE
D2
AC
A.C. DIST
TEST CONSOLE #1
TEST CONSOLE #2
FAULT



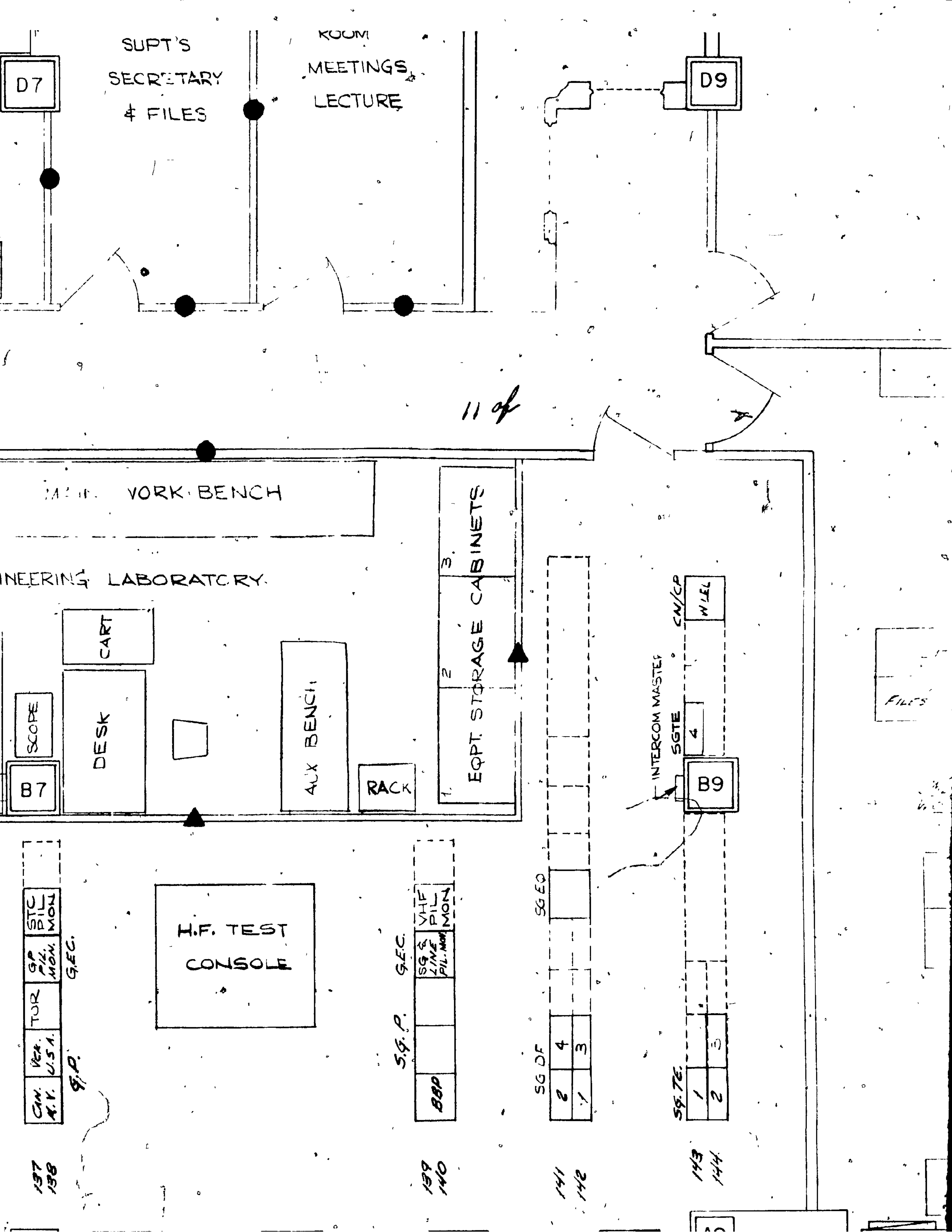
ITMC INSTALLATION TO BEGIN HERE
105
106
MISC
MAN CCTS.
CANT I & II
CANT II
M V 1-6
7-1/4
V. F
MISC
MISC
TOR
A B C D E F G H I J K L M N O P Q R S T U V W X
8 of
S.F RINGERS
TASI-B DLC
MISC. EQUIP'T
107
108
BAYLY AMPS
WESC E4B
23"
VHF
B3
E.O.W
DEL EQ
BAYLY ATTEN
PULSE COM ATTEN
Y.F. RINGERS
V.H.F
OMNIBUS ORDER WIRES
D3
109
110
931C
931C
931C
931C
931C
931C
931C
931C
931B
931B
931B
CIT.
ECHO SUPP
ECHO SUPP
BDCB
111
112
FUTURE ECHO SUPP.
113
114
FUTURE ECHO SUPP.
AIR COND.
D4
INTERCOM MASTER



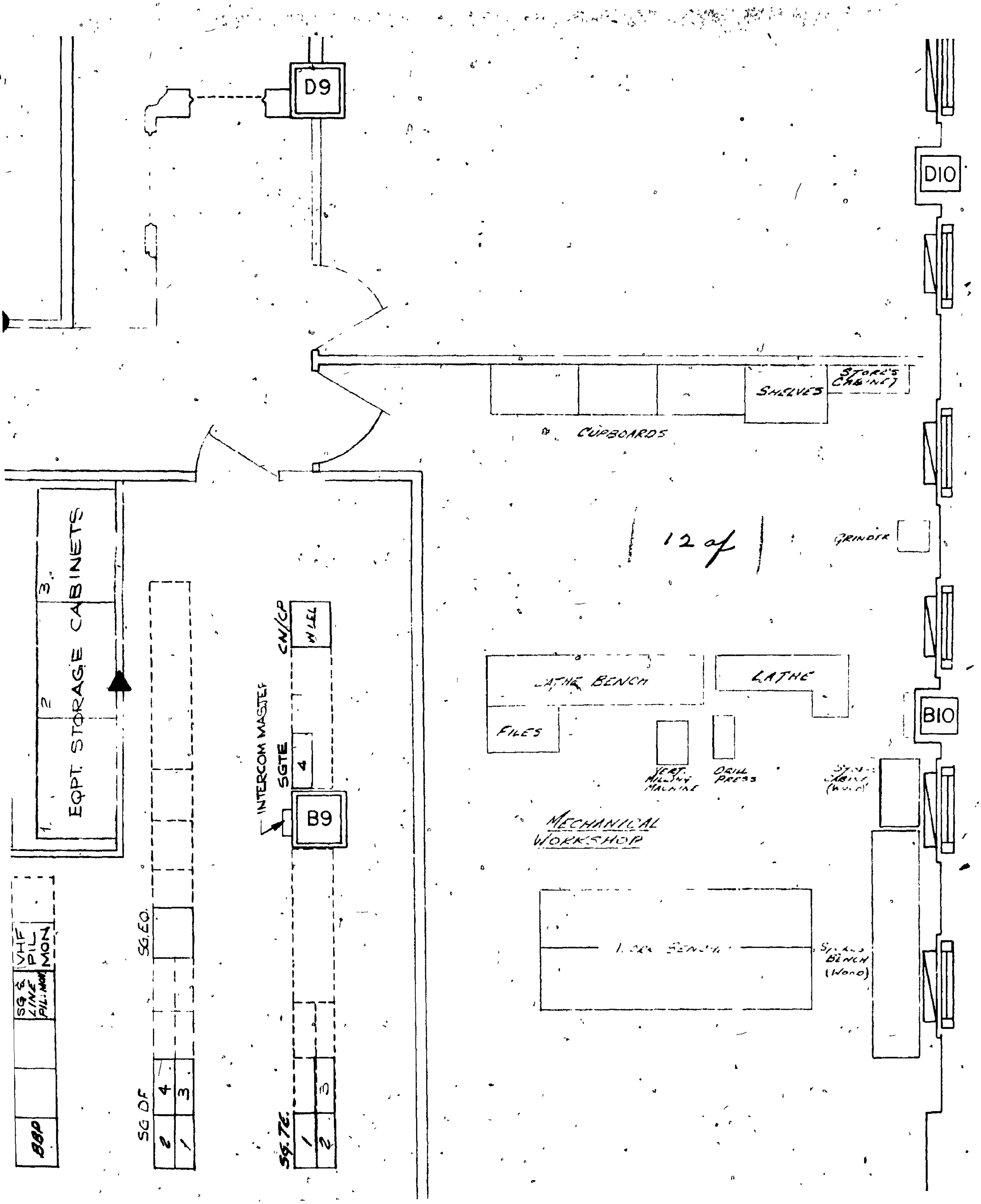
D5
D6
C5
C6
9 of
FUTURE 3KHZ OR ECHO SUPP.
INTERCOM SPKR
B5
AC DIST.
FUTURE 3KHZ CH. BKS.
(TEMPORARY AISLE)
(THIS SUITE TO BE EQUIPPED AT LATER DATE)
3KHZ CTE
NIPPON ELECT.
CTE
CIT
B.G.A
3 KHZ CTE
TMC
CTE
TMC
STC
STC
STC
GEC
(TMC)
INTERCOM SPKR.
BDCB
B6
KAS-CTE
115
116
117
118
119
120
121
122
123
124
125
126
127
128
INTERCOM MASTER
INT



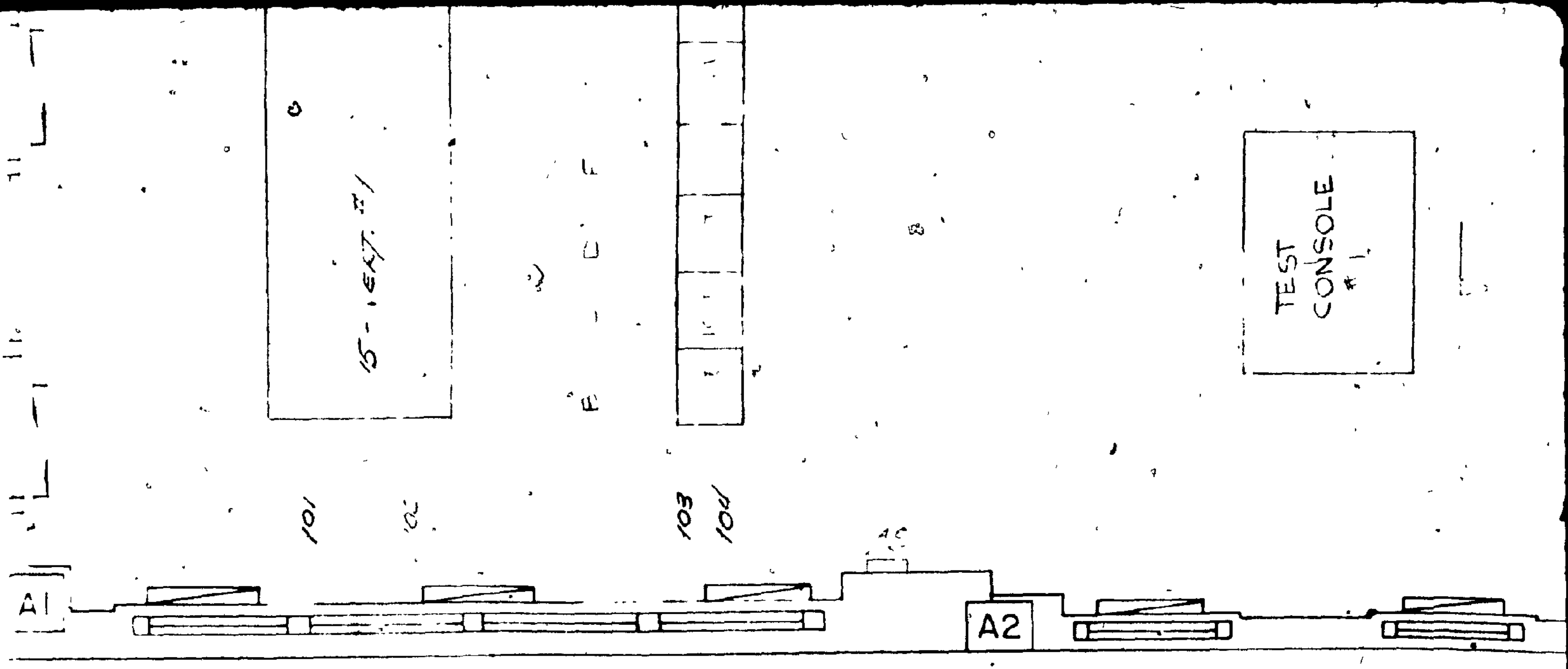
SUPT
SECRE
& FIL
D6
C6
AIR COND
XMTR #2
XMTR #1
RCVR #1
RCDR
RCVR #2
D7
FACSIMILE ROOM
TABLE
PATCH BAY
10 of
MAIN WORK
ENGINEERING LABO
COMPONETS CAB.
MOVABLE LADDER
STORAGE CABINET
FILES
DRAFTING TABLE
SCOPE
B7
DESK
CART
INTERCOM SPKR
BDCB
4
3
INTERCOM SPKR
B6
PROG EQUIPMENT TMC
BAYLX MIB
NIP. EL.
TMC STC STC STC GEC
(TMC)
MAS-GTE
2 1 4 3
MAS CARR. GEN
DUMMY 1
CARR GEN
TYPE G2
DIST
STC STC STC
GTE MAS
TGF
4 3
TGF
GP EQLZR
GP EQLZR
GTE & AGL
2 1
MAS (TMC) TMC STC G.E.C MAS
FUTURE GDF
GDF
2 1 4 3 6 5 8 7
CAN. N.Y.
VCR U.S.A.
TUR
GP PIL MON.
STC PIL MON.
G.E.C.
G.P.
125 126
127 128
129 130
131 132
133 134
135 136
137 138
INTERCOM MASTER



SUPT'S SECRETARY & FILES
MEETINGS LECTURE
D7
D9
11 of
VORK BENCH
LABORATORY
EQPT. STORAGE CABINETS
1
2
3
CART
SCOPE
DESK
AUX BENCH
RACK
B7
B9
INTERCOM MASTER
SGTE
4
CN/CP
FILES
H.F. TEST CONSOLE
STC PIL MON
GP PIL. MON.
TUR
VER. U.S.A.
CAN. A.V.
G.E.C.
G.P.
VHF PIL MON
SG & LINE PIL. MON
S.G.P.
BBP
SG EQ
SG DF
SG. TE.
137 138
139 140
141 142
143 144



D9
D10
B10
B9
CUPBOARDS
SHELVES
STORE'S CABINET
12 of
GRINDER
LATHE BENCH
LATHE
FILES
VERT. MILLING MACHINE
DRILL PRESS
MECHANICAL WORKSHOP
EQPT. STORAGE CABINETS
INTERCOM MASTER
SGTE
CN/CP
SG.EQ.
SG DF
SG.TE.
VHF PIL MON
SG & LINE PIL MON
BBP



LEGEND:-

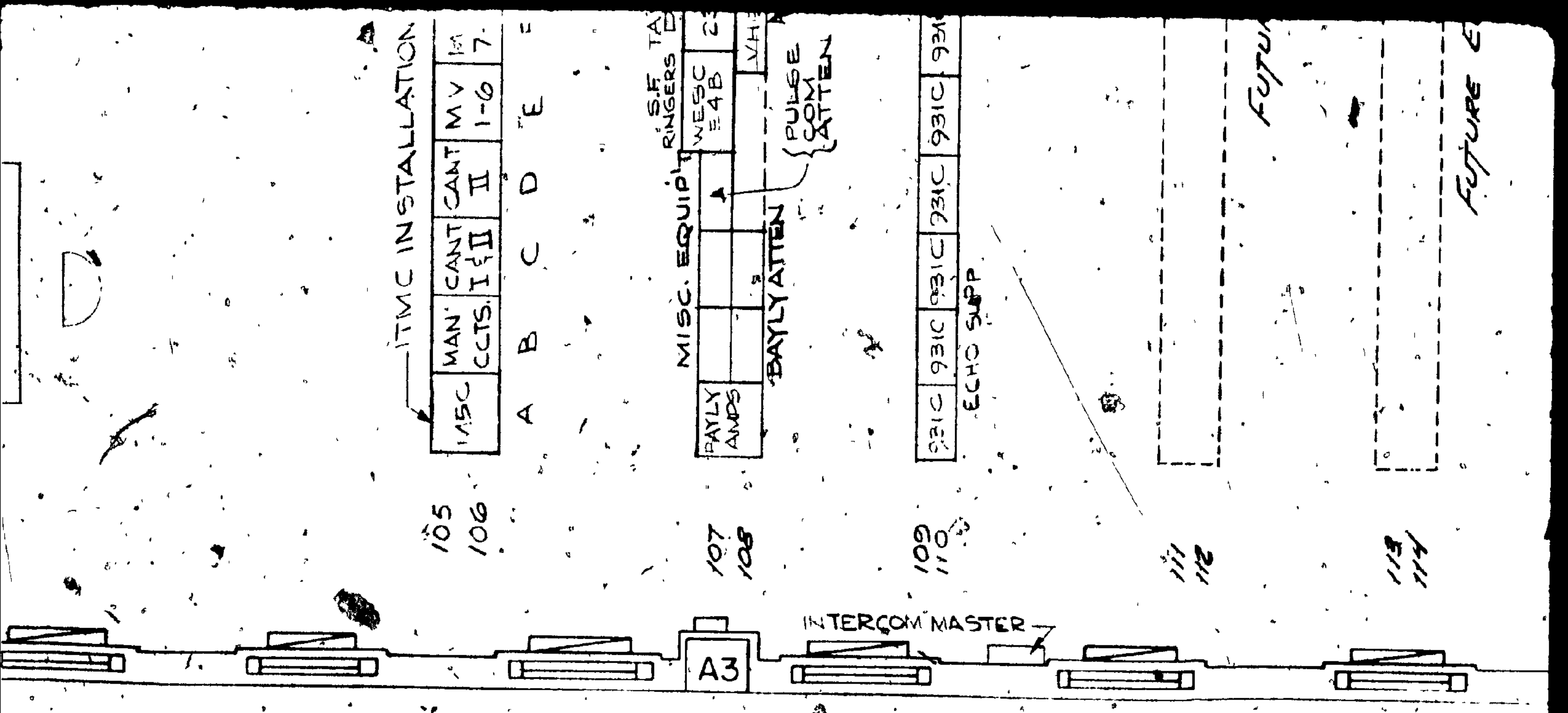
● FLOOR TO CEILING WEST[illegible]

▲ 8'-0" WESTROCK PAR[illegible]

⧗ GLASS & STEEL PART[illegible]

13 of

ISS. No.	AMENDMENTS
[illegible]	REVISED [illegible] -70
35	[illegible] 23-9-70
36	MISC. BAY ADDED TO LAB. ALSO SUITES 7,8,9,10,11,12,13,14,17 & 18 REVISED 3-2-71 HS
37	Suites 1, 2, 3 & 4 and Telegraph Revised 30 March 71
38	Suites 9 10, 11, 12, 13, 14, 49 [illegible] 53, 54, 59 & 60 Revised. HS
39	Revised 24 Aug 71
40	REVISED H.B 28 12 1971
41	REVISED 29-5-72
42	REVISED 14-9-72
43	COMMERCIAL & TECHNICAL SUPT OFFICES REMOVED 5-12-72
44	REVISED TO SHOW PROJECT #10 EXPANSION. R.K.
45	REVISIONS TO PROJ. #10 EXPANSION. 24-8-73
46	CN/CP ADDED TO SUITES 143/144 18-3-73.
47	SUITES REVISED FEB-12-7[illegible]



G WESTROCK PARTITIONS

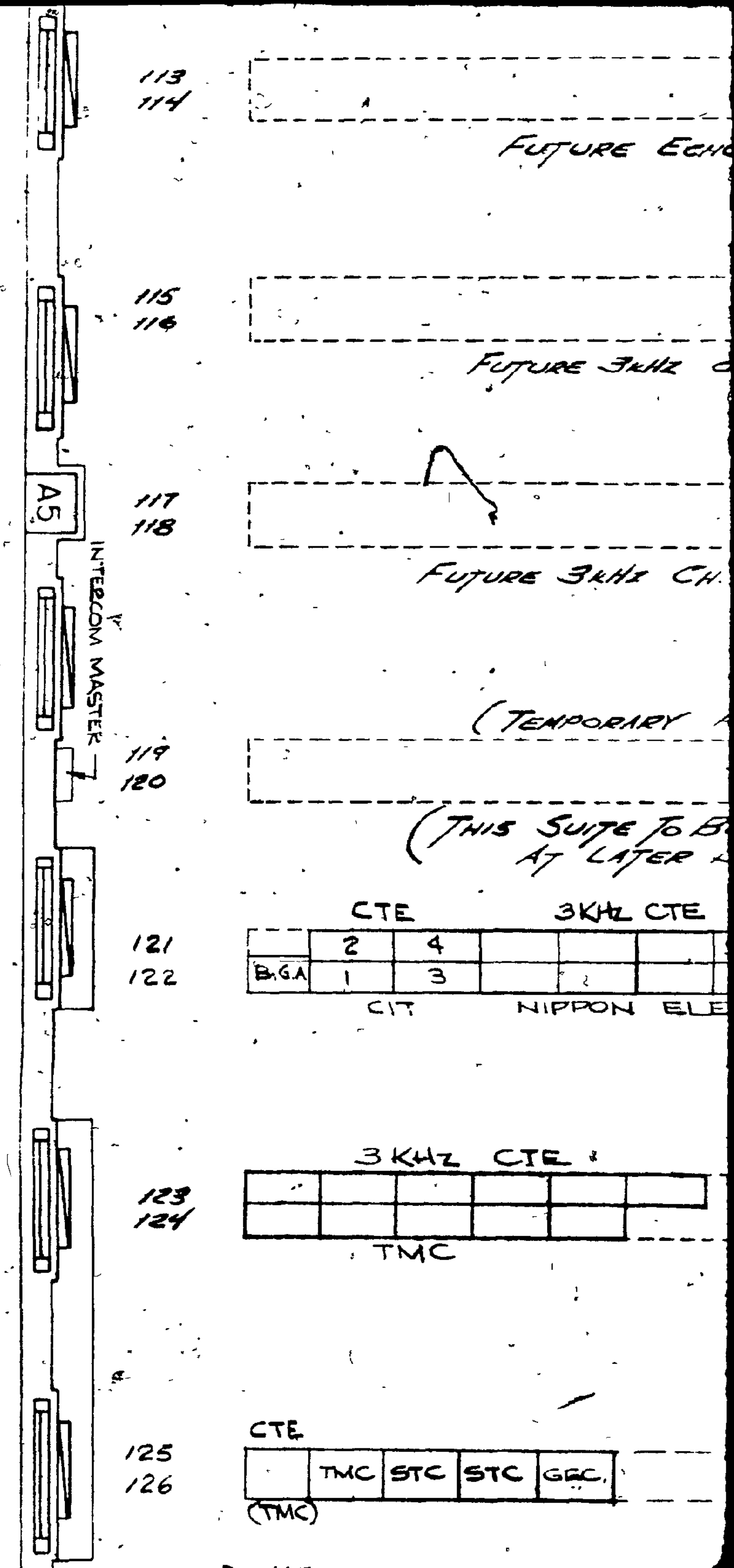
K PARTITIONS

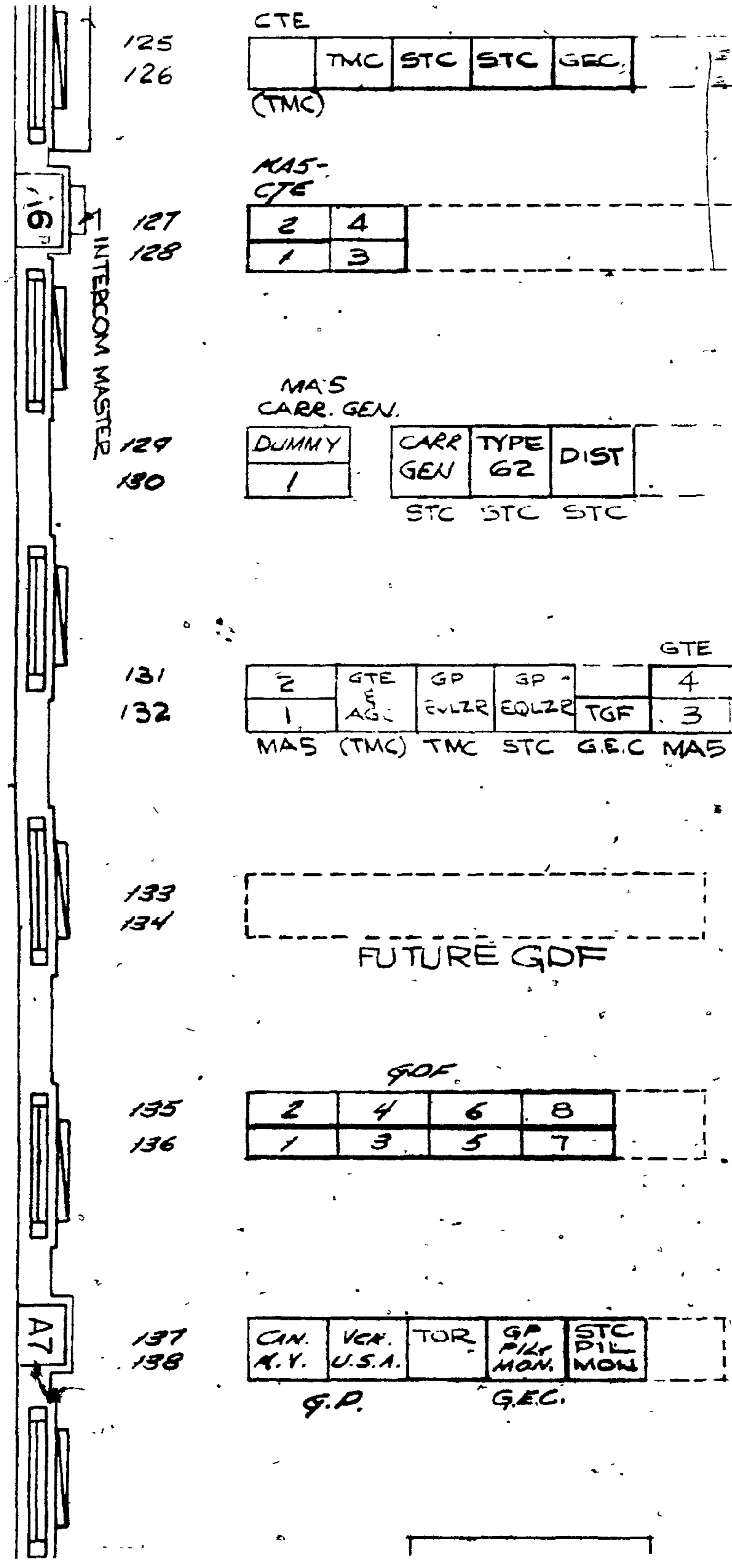
PARTITIONS.

14 of

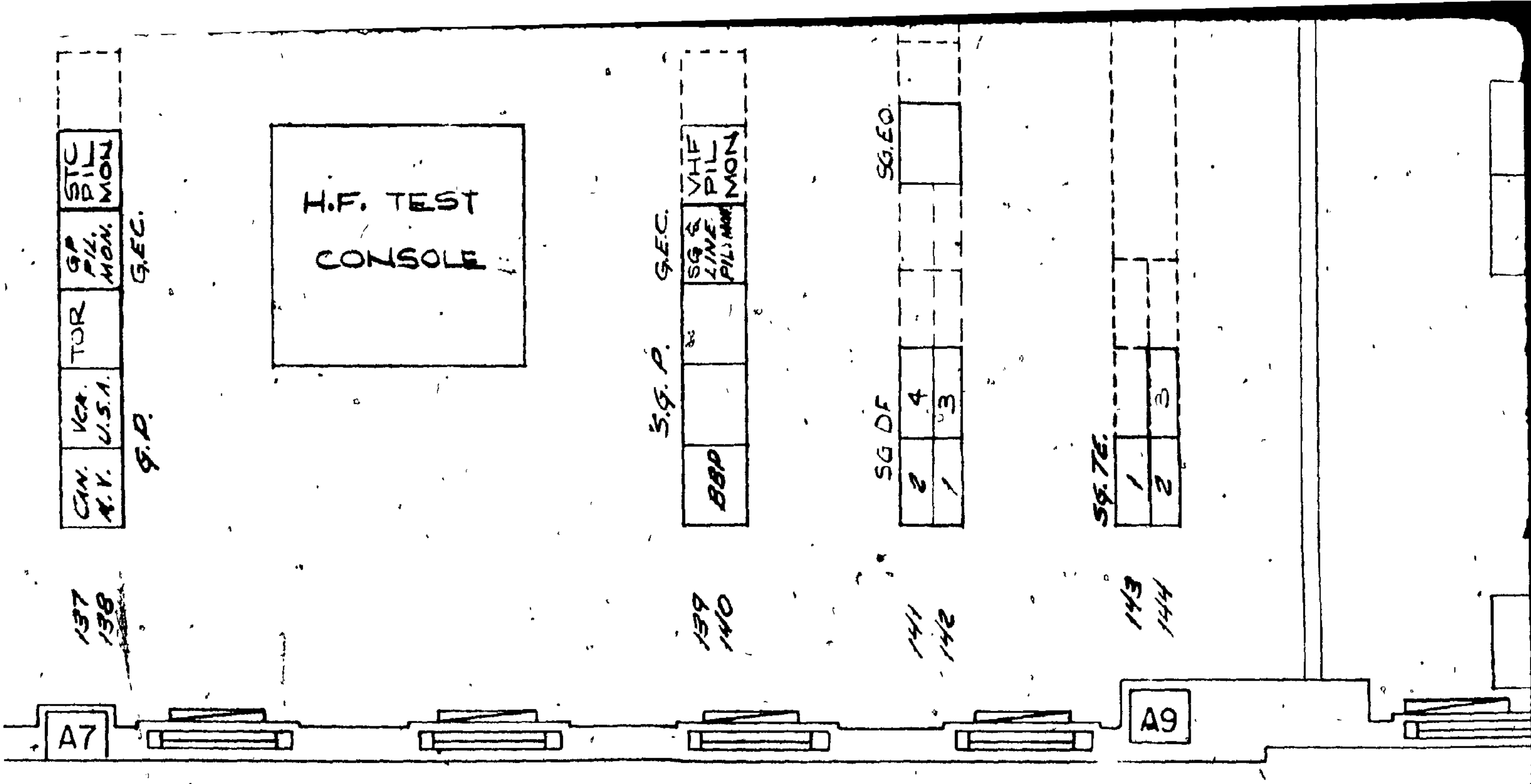
46	CN/EP ADDED TO SUITES 147/148. 18-9-73.
47	SUITES REVISED FEB-13-74 AB
48	ENGR. LAB. TECH SUPT. & MEETING ROOM ADDED. SPARES STORAGE RELOCATED. 15-7-74.
49	EQUIP. LOCATIONS REVISED AS PER EXISTING DIMENSIONS 5-3-75 PJS
50	POWER ROOM EQPT REVISED TO AGREE WITH EXISTING LAY-OUT.
51	CONDUITS FROM 2ND TO 1ST FLOOR SHOWN 30-9-75 MM
52	REMOVED SUITES 17,18,21 & 22. ADDED PBC AREA & 1SPC CONSOLES. NOV 8/75
53	H.F. TEST CONSOLE & FAULT REPORT CENTER ADDED. ADDITIONS AND CHANGES TO SUITES 9,10,13,14,15,16,103,104,105,106,107,108,109,110,121,122,123,124,125,126,127,128,129,130,131,132,135,136,137,138,139,140,143,144. 23-12-76 NS
54	REMOVED SUITES 1,2,3,4,7,8,9,10,11,12,13,14,15,16,17,18,19,20 AND 1SPC CONSOLES ADDITIONS AND CHANGES TO SUITES 107,108,109,110

	1,2,3,4,7,8,9,10,11, 12,13,14,15,16,17, 18,19,20, AND ISPC CONSOLES ADDITIONS AND CHANGES TO SUITES 107,108, 109,110. 21-2-78 MS
55	NEW EQPT ADDED MAR. 29/78 GRY RND
56	SUITE Y,Z [illegible] ADDED [illegible] CONSOLE REARRANGED JUNE 16/78



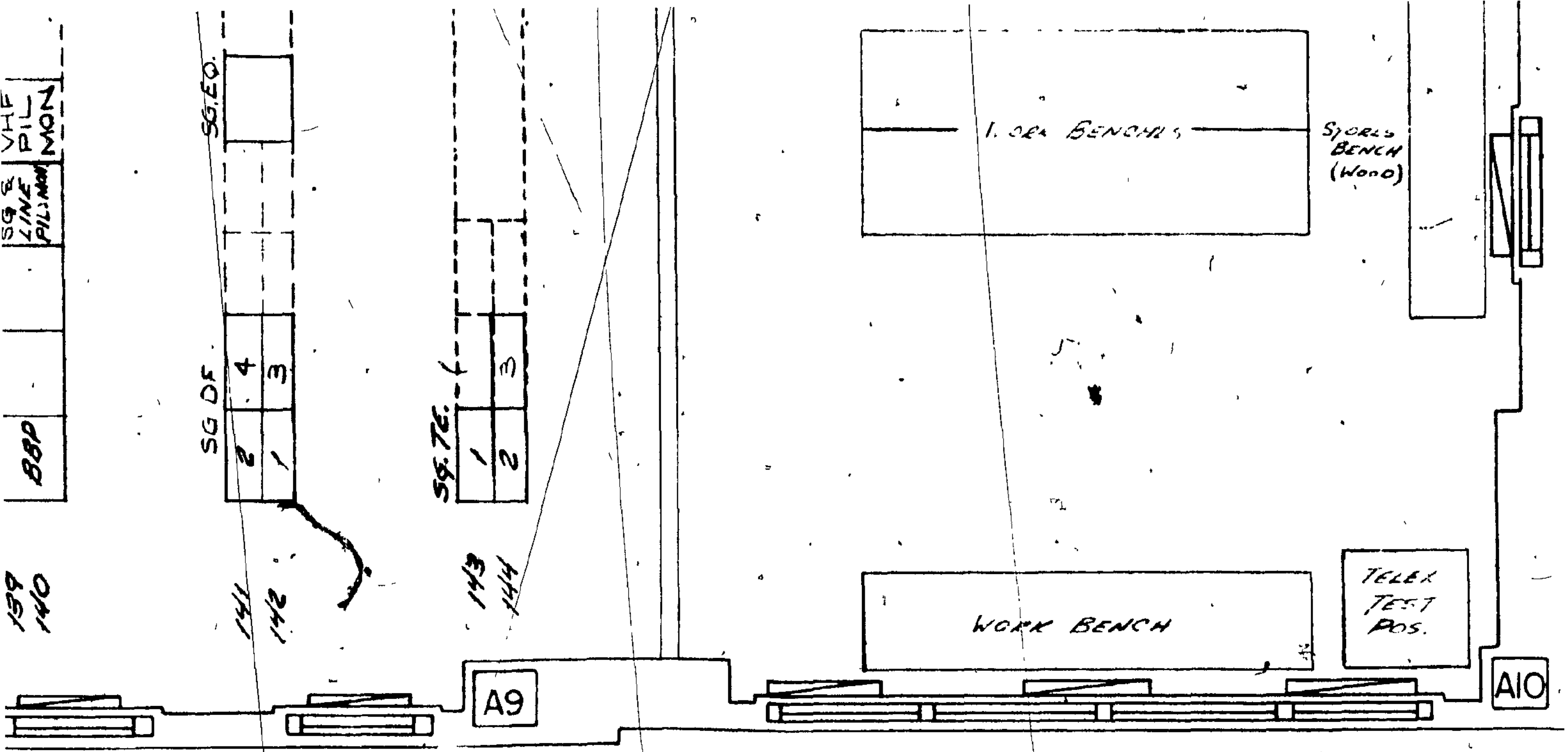

CTE
TMC
STC
STC
GEC.
(TMC)
125
126
MAS-CTE
2
4
1
3
127
128
16
INTERCOM MASTER
MAS CARR. GEN.
DUMMY
1
CARR GEN
TYPE 62
DIST
STC
STC
STC
129
130
131
132
2
1
GTE & AGC
GP EQLZR
GP EQLZR
TGF
GTE
4
3
MAS
(TMC)
TMC
STC
G.E.C
MAS
133
134
FUTURE GDF
GDF
2
4
6
8
1
3
5
7
135
136
137
138
A7
CAN. N.Y.
VCR. U.S.A.
TOR.
GP PILT MON.
STC PIL MON
G.P.
G.E.C.

16 of



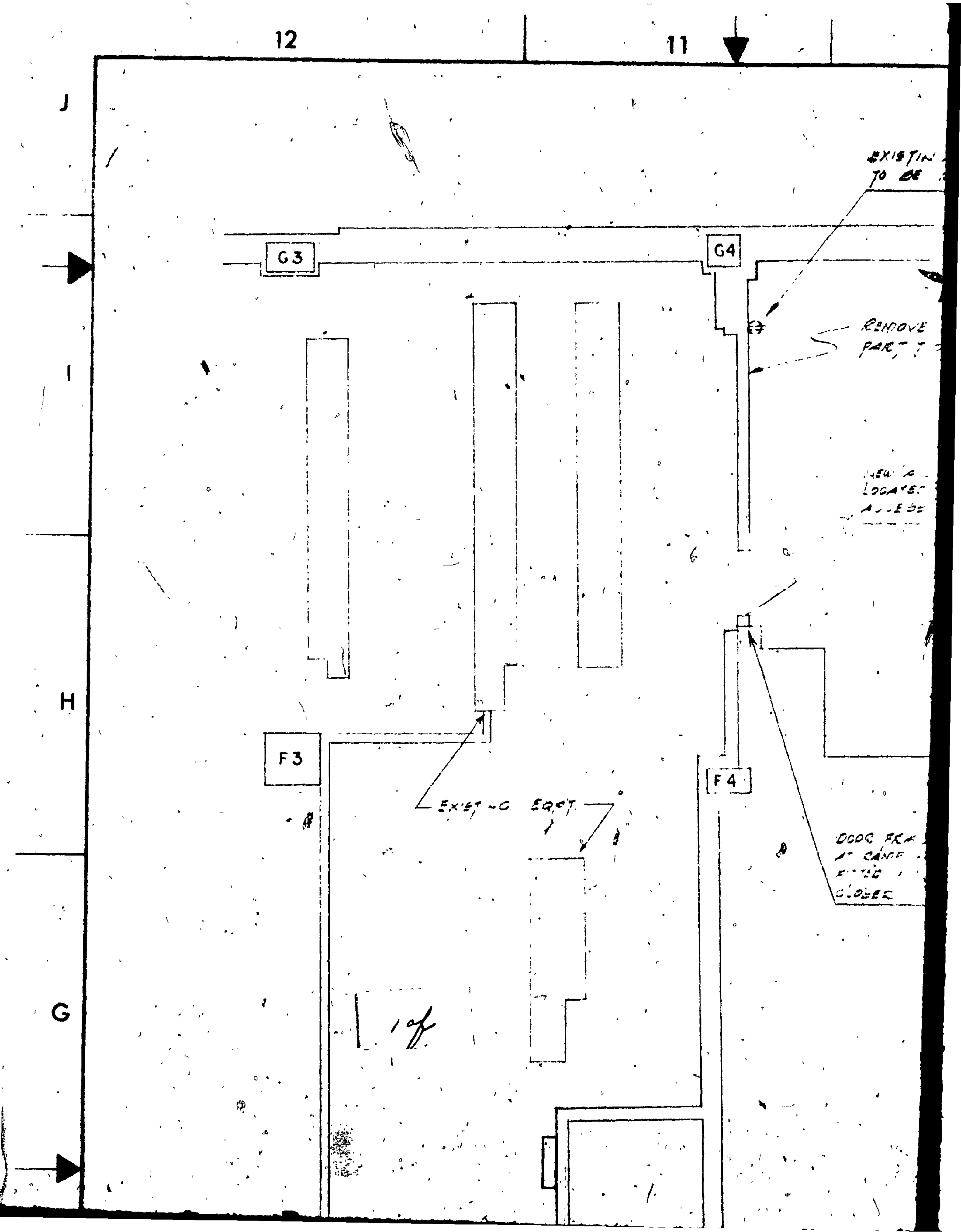
17 of

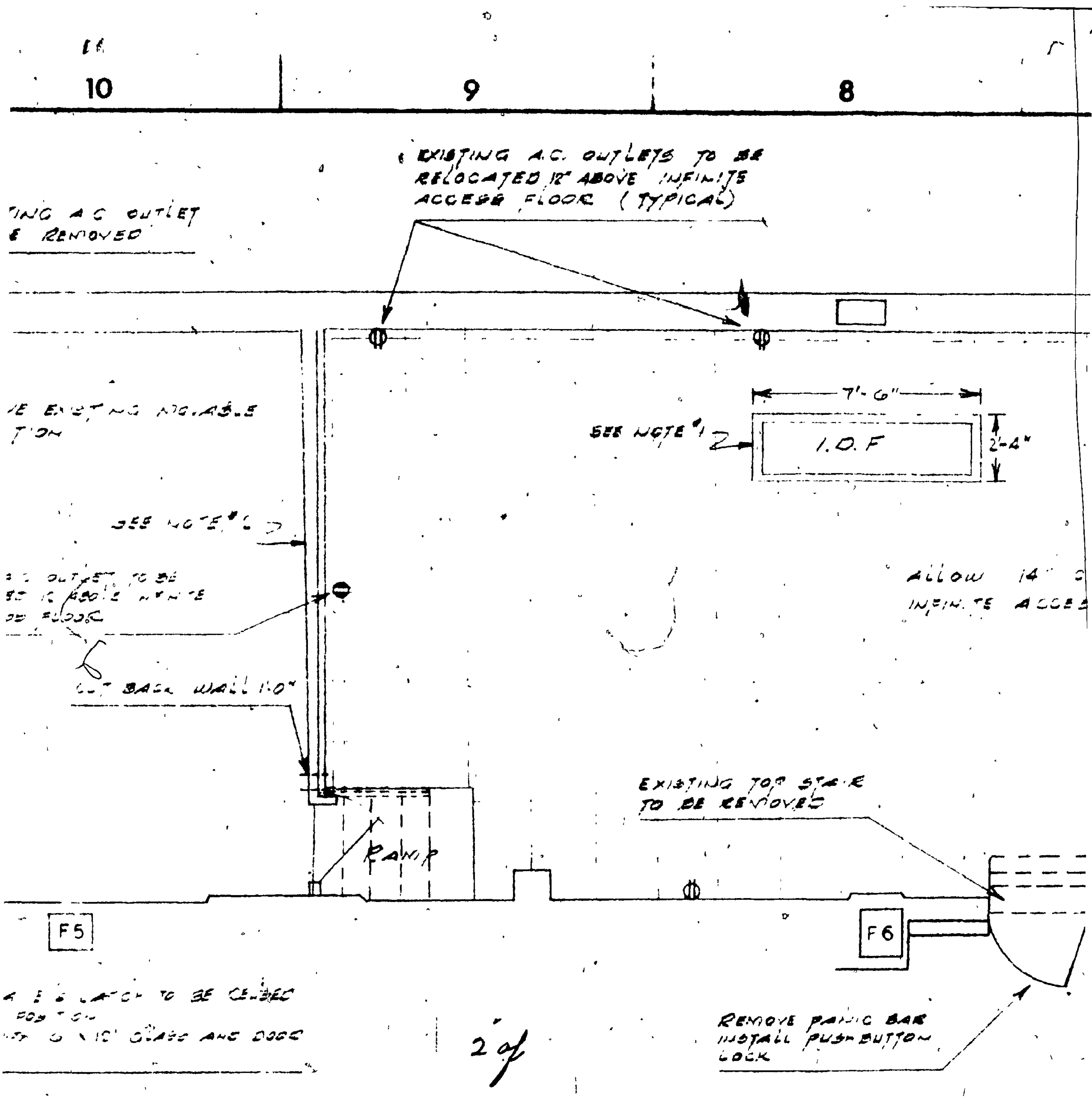
DRAWN CANNING	
PREPARED CANNING	TEL
VERIFIED	MONT
SUBMITTED	
APPROVED	SCALE.
DWG.	B5



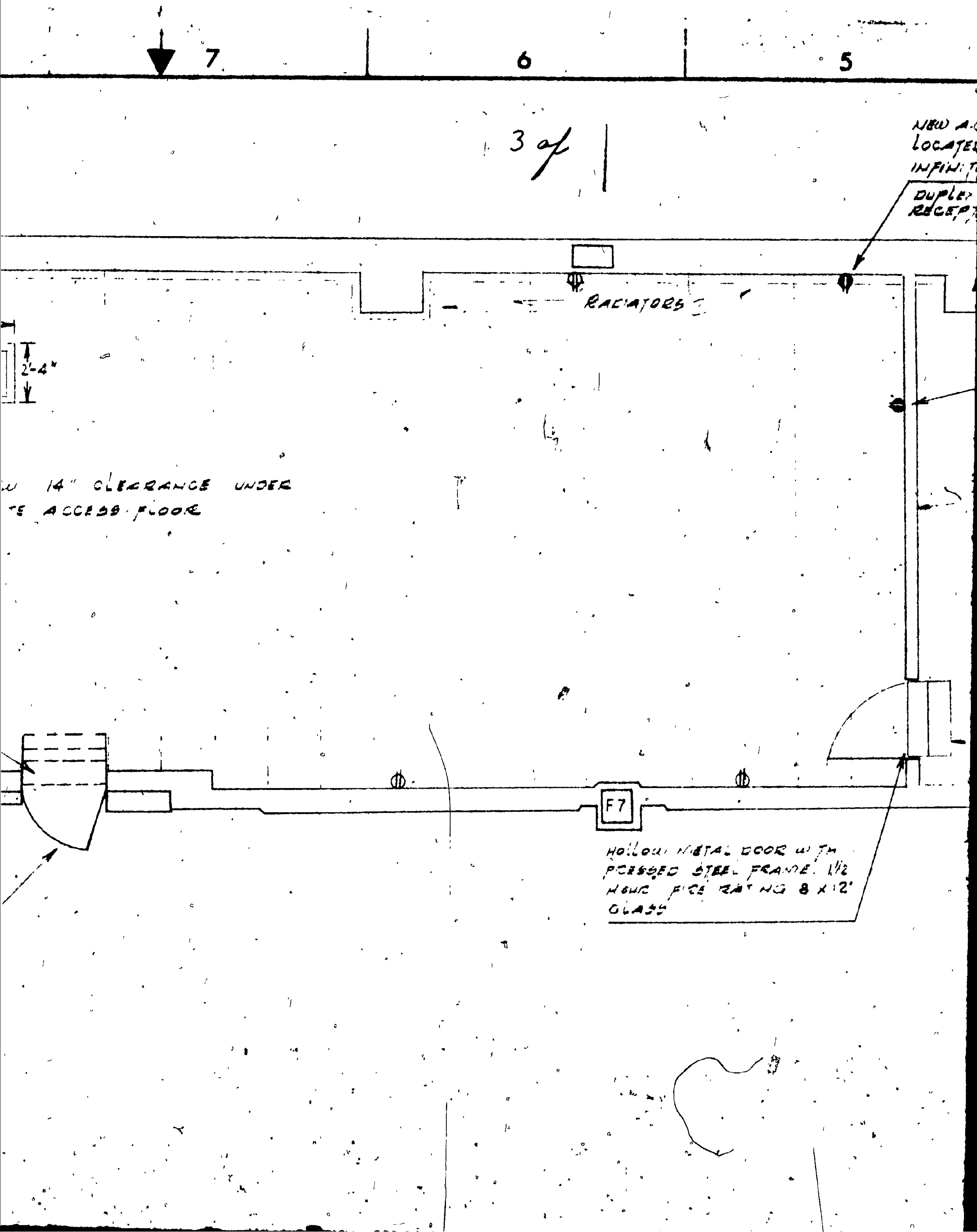
18 of 18

DRAWN CANNING	CANADIAN OVERSEAS TELECOMMUNICATION CORP.
PREPARED CANNING	
VERIFIED	MONTREAL OVERSEAS TERMINAL 2nd Floor EQUIPMENT LAYOUT
SUBMITTED	
APPROVED	SCALE. 1/4" = 1 FOOT (APPROX.)
DWG. B5/E/1.1/2	SHT. 1 OF 1

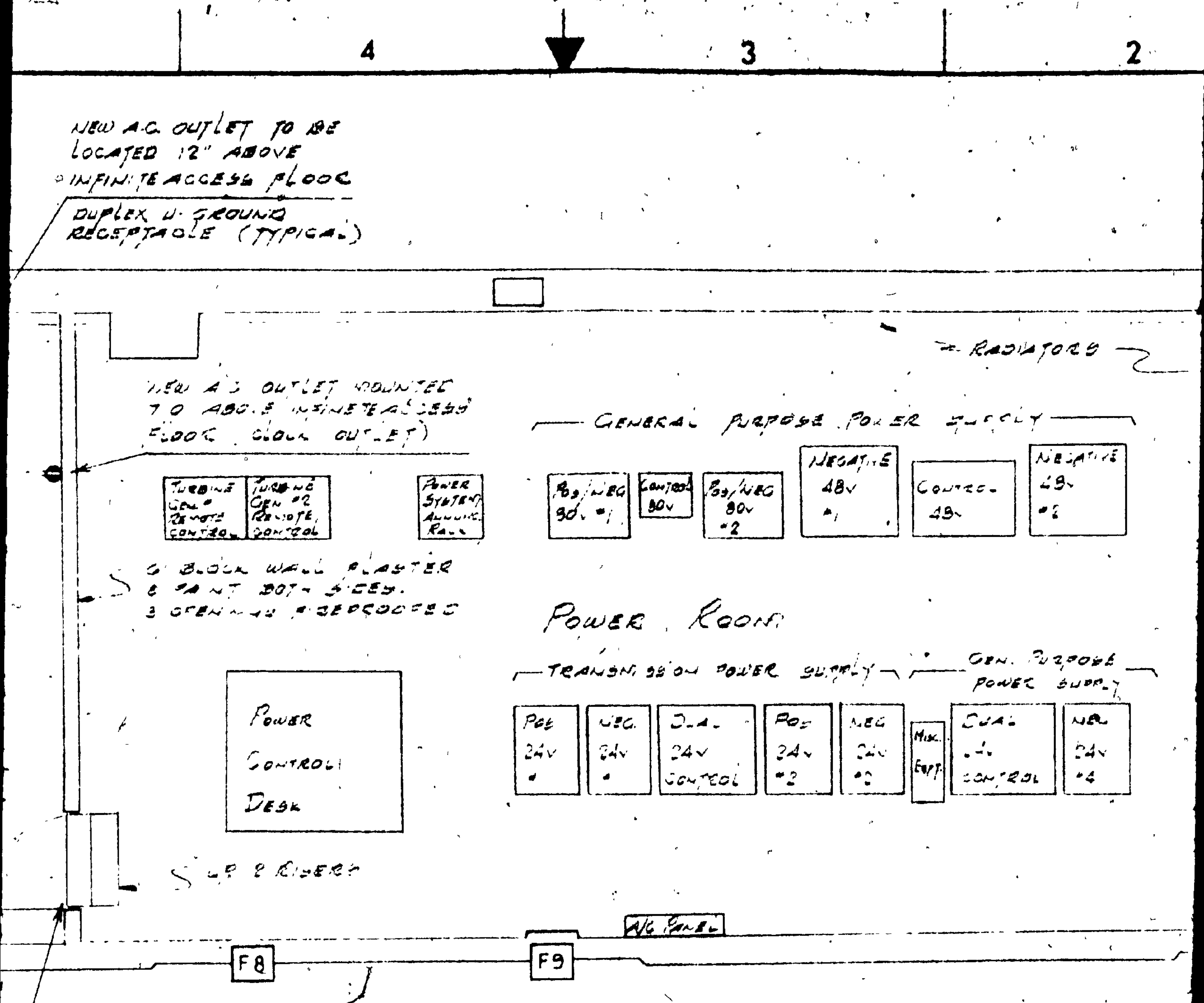

12
11
J
I
H
G
G3
G4
F3
F4
REMOVE
EXISTING EQPT
CLOSER



10
9
8
EXISTING A.C. OUTLETS TO BE RELOCATED 12" ABOVE INFINITE ACCESS FLOOR (TYPICAL)
7'-6"
SEE NOTE #1
1.O.F
2'-4"
EXISTING TOP STAIR TO BE REMOVED
RAMP
F5
F6
REMOVE PANIC BAR INSTALL PUSH-BUTTON LOCK
2 of



7
6
5
3 of
RADIATORS
2'-4"
14" CLEARANCE UNDER
ACCESS FLOOR
F7
HOLLOW METAL DOOR WITH PRESSED STEEL FRAME. 1½ HOUR FIRE RATING 8 x 12' GLASS

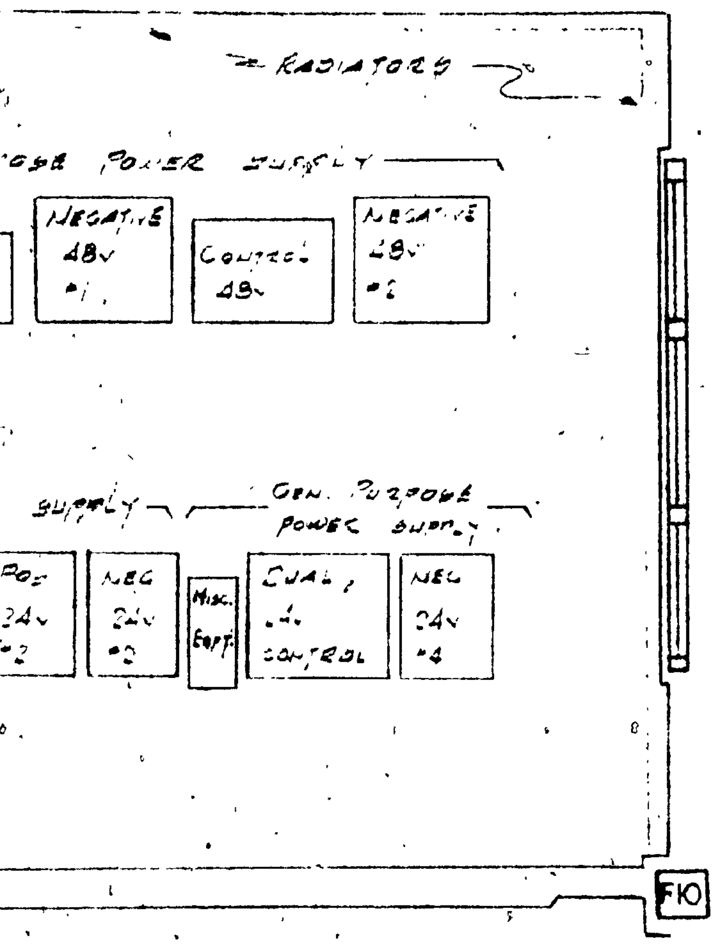


4
3
2
NEW A.C. OUTLET TO BE LOCATED 12" ABOVE INFINITE ACCESS FLOOR
DUPLEX W. GROUND RECEPTACLE (TYPICAL)
RADIATORS
GENERAL PURPOSE POWER SUPPLY
TURBINE GEN #1 REMOTE CONTROL
TURBINE GEN #2 REMOTE CONTROL
POWER SYSTEM ANNUNC. RACK
POS/NEG 80v #1
CONTROL 80v
POS/NEG 80v #2
NEGATIVE 48v #1
CONTROL 48v
NEGATIVE 48v #2
POWER ROOM
TRANSMISSION POWER SUPPLY
GEN. PURPOSE POWER SUPPLY
POWER CONTROL DESK
POS 24v #1
NEG. 24v #1
DUAL 24v CONTROL
POS 24v #2
NEG 24v #2
Misc. Eqpt.
DUAL 24v CONTROL
NEG 24v #4
A/C PANEL
F8
F9

4 of

2 1

J I H G

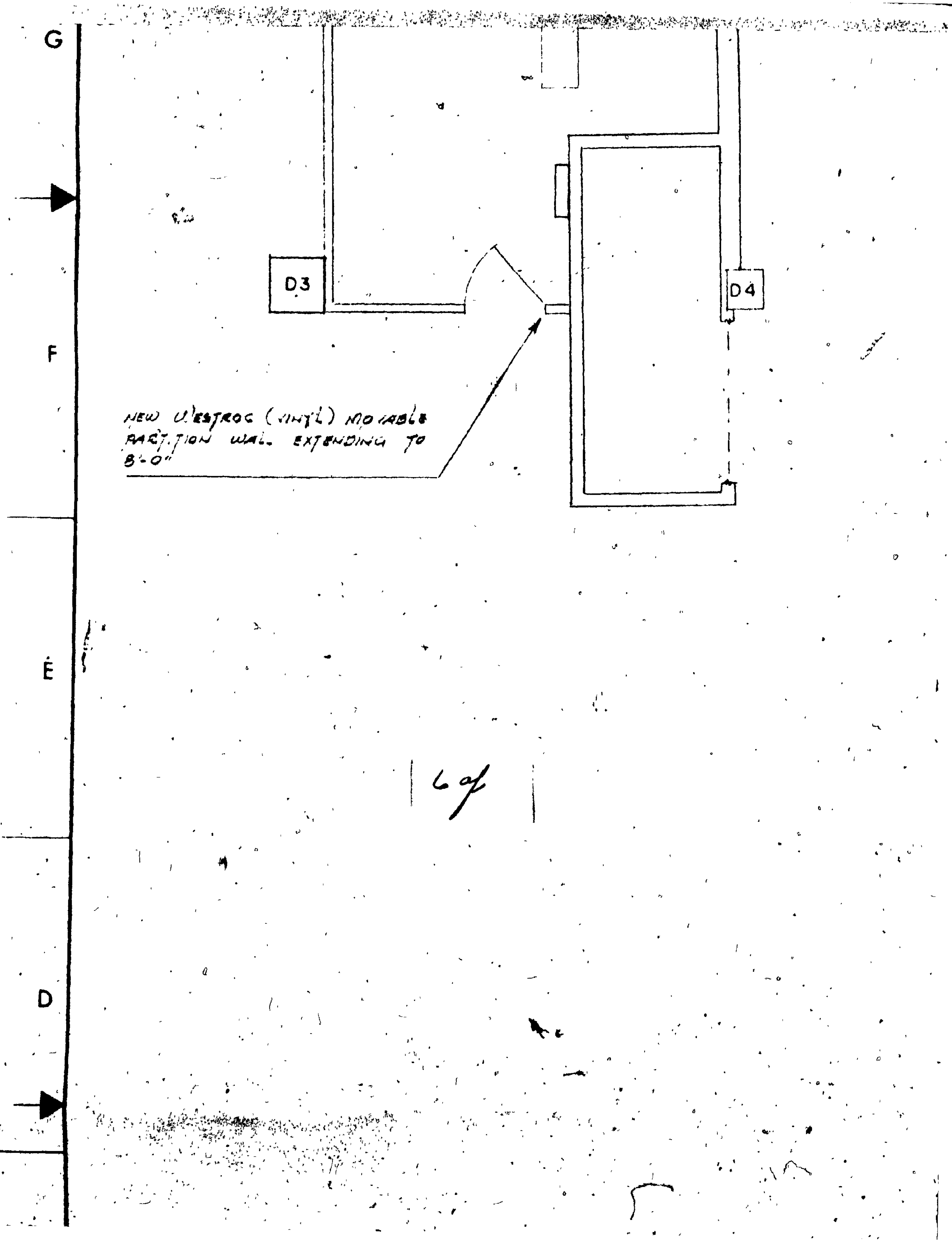


NOTES

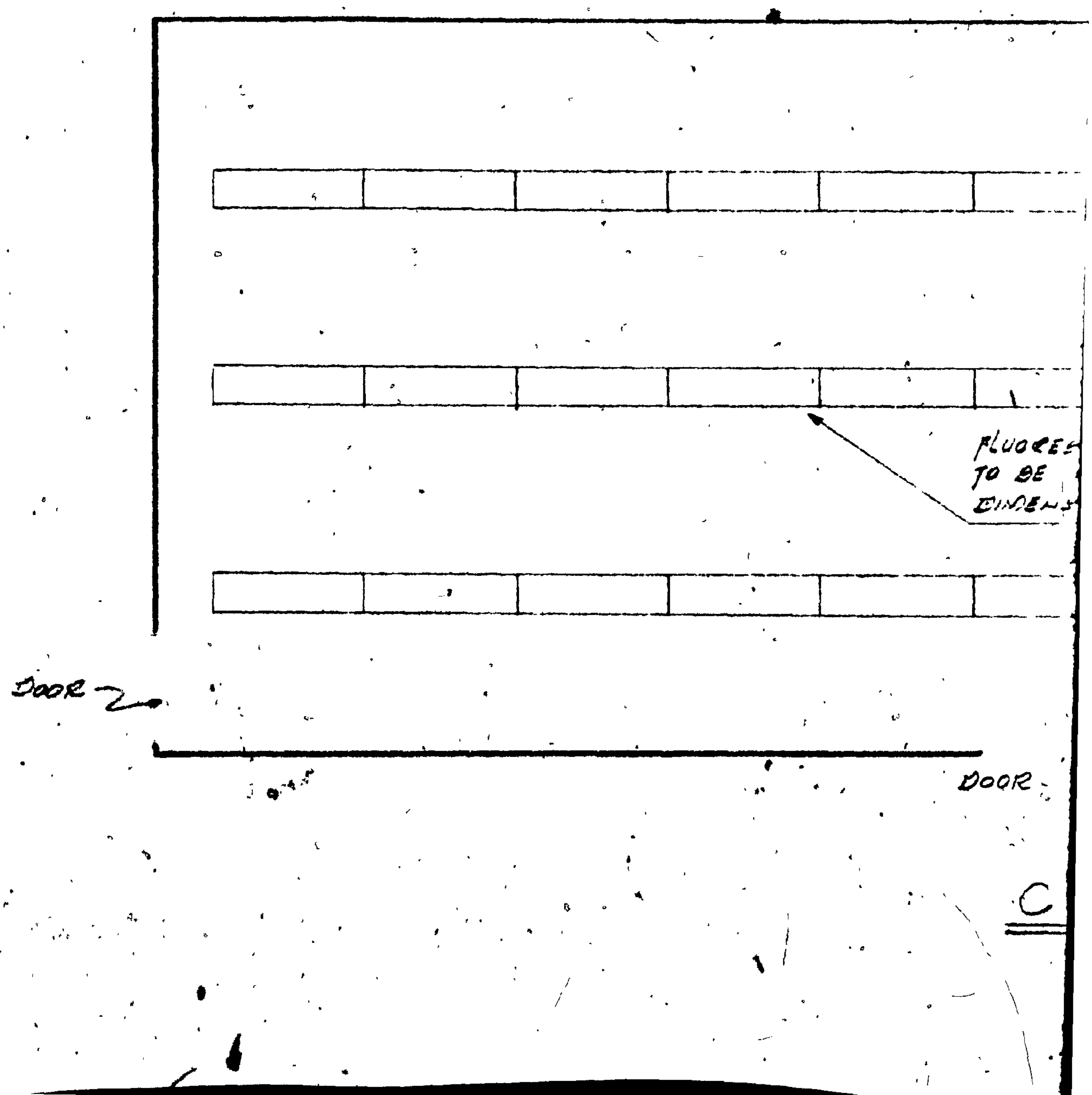
1) PROVIDE OPENING IN INFINITE ACCESS-FLOOR AS PER DIMENSIONS

2) REMOVE EXISTING RAILING, BUILD WEBTROC (VINYL) MOVABLE PARTITION WALL EXTENDING TO CEILING
- FIVE (5) OPENINGS FOR CABLE RACKS TO BE SUITABLY FINISHED WITH MOULDING
- INSTALL TWO (2) WINDOWS 36" x 36" SUITABLY LOCATED AT EACH SIDE OF CENTRALLY POSITIONED VERTICAL CABLE RACKS

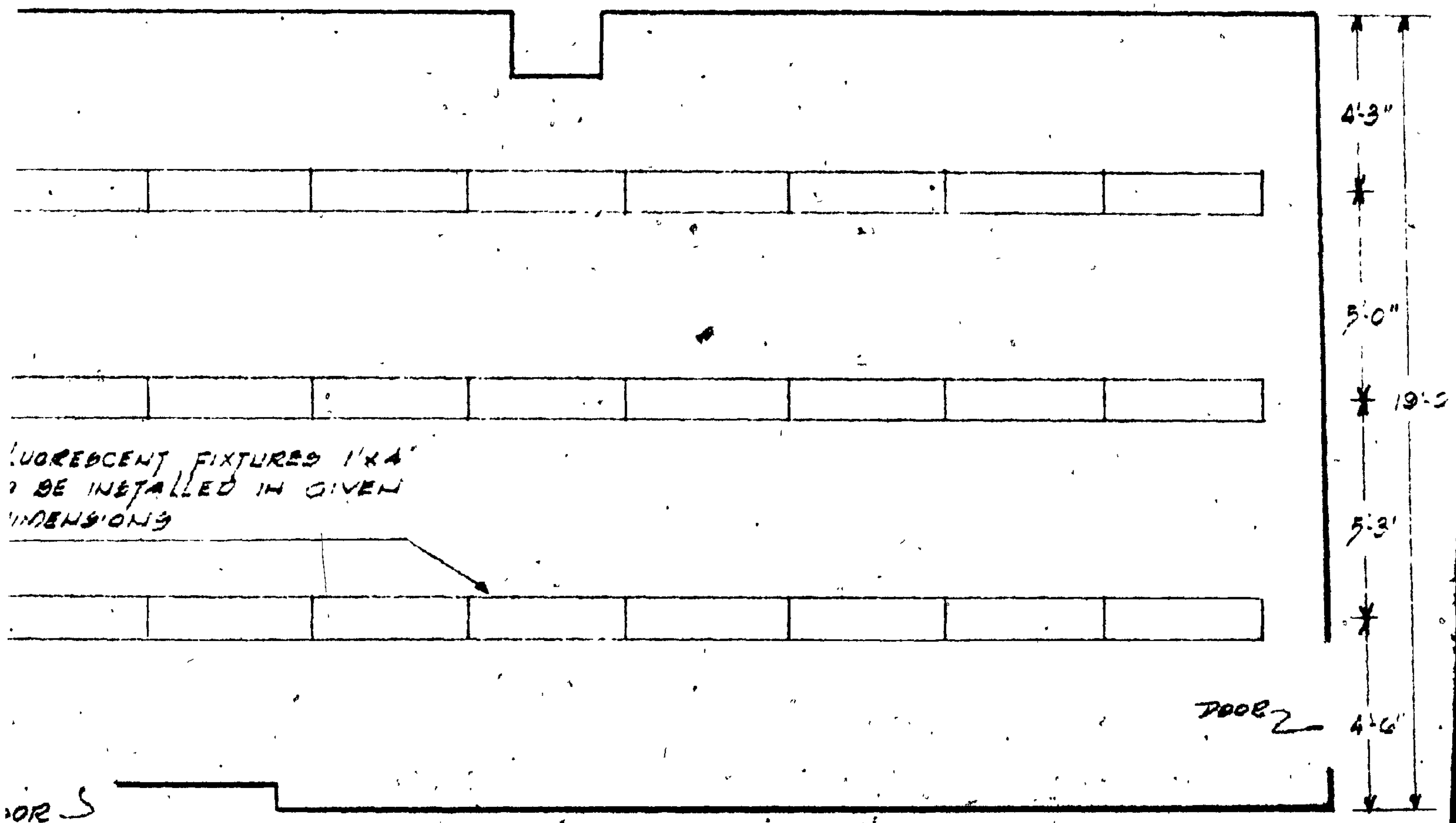
5 of


G
F
E
D
D3
D4
NEW WESTROC (VINYL) MOVABLE PARTITION WALL EXTENDING TO 8'-0"
6 of

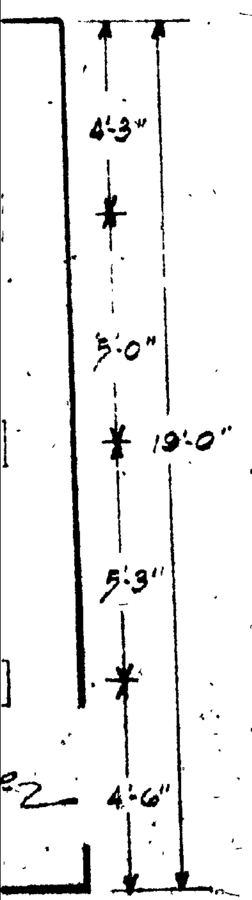
4 of



8 of



CEILING PLAN



9 of

G

F

E

10 of

D

D

C

B

11 of

REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DA
1	AUG. 25 1975	[illegible]																	

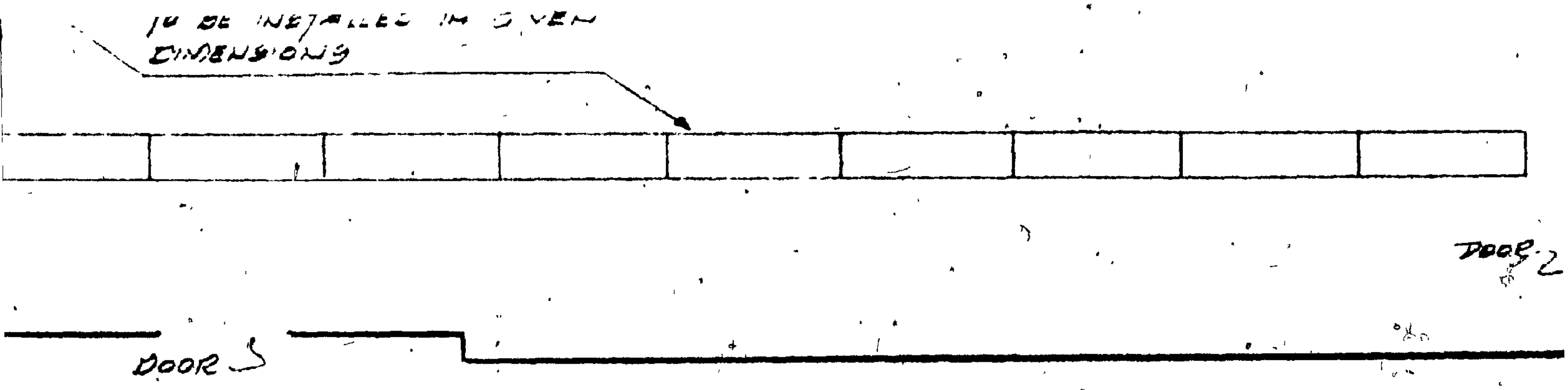
A

12 11

DOOR 2

12 of 1

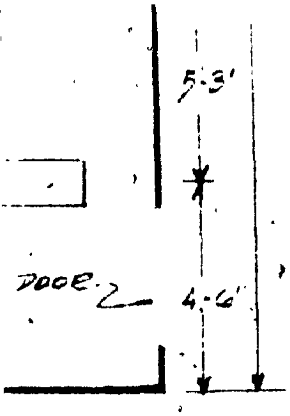
INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE



CEILING PLAN

REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT

13 of



E	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT	REV.	DATE

14 of

4 3 2

15 of 15

REV	DATE	INIT	REV	DATE	INIT	REV	DATE	INIT

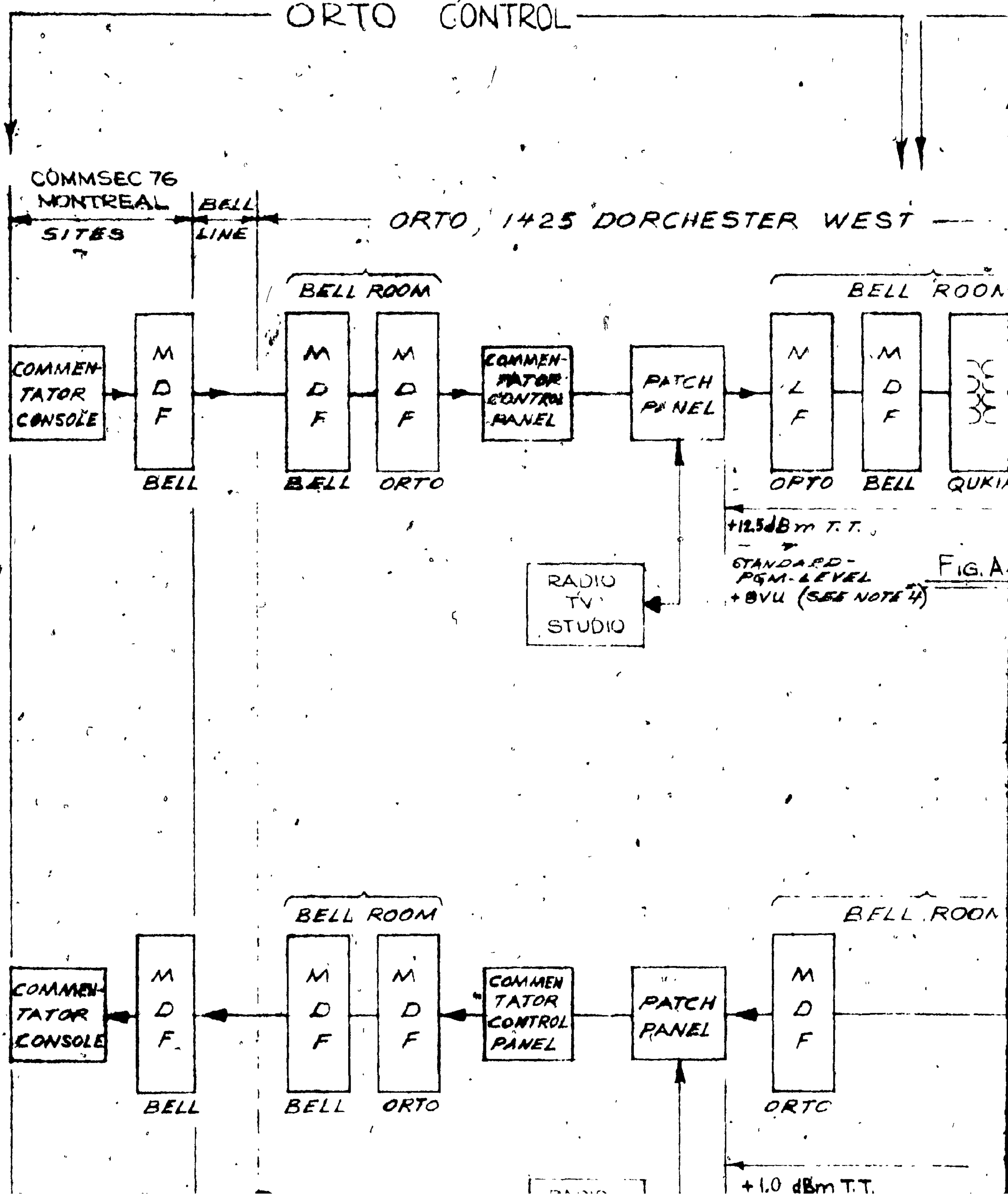
DRAWN / DESSINÉ: DJS
PREPARED / PRÉPARÉ
VERIFIED / VÉRIFIÉ
SUBMITTED / PRÉSENTÉ
APPROVED / APPROUVÉ

MONTREAL 2ND FLOOR RENOVATIONS FOR INTERNATIONAL SOUND PROGRAM CONTROL INSTALLATION

Scale - Échelle 1/4" = 1'-0" (APPROX)

No. BPS/F/1.1/21 — SHEET-FEUILLE 1 — OF-DE 1

REVISION/RÉVISION NO. ① 2 3 4 5 6 7 8 9 0



ORTO CONTROL
COMMSEC 76 MONTREAL SITES
BELL LINE
ORTO, 1425 DORCHESTER WEST
BELL ROOM
COMMENTATOR CONSOLE
M D F
BELL
M D F
BELL
M D F
ORTO
COMMENTATOR CONTROL PANEL
PATCH PANEL
RADIO TV STUDIO
N L F
OPTO
M D F
BELL
QUKI
+12.5dBm T.T.
STANDARD PGM LEVEL +8VU (SEE NOTE 4)
FIG. A
BELL ROOM
COMMENTATOR CONSOLE
M D F
BELL
M D F
BELL
M D F
ORTO
COMMENTATOR CONTROL PANEL
PATCH PANEL
M D F
ORTC
+1.0 dBm T.T.

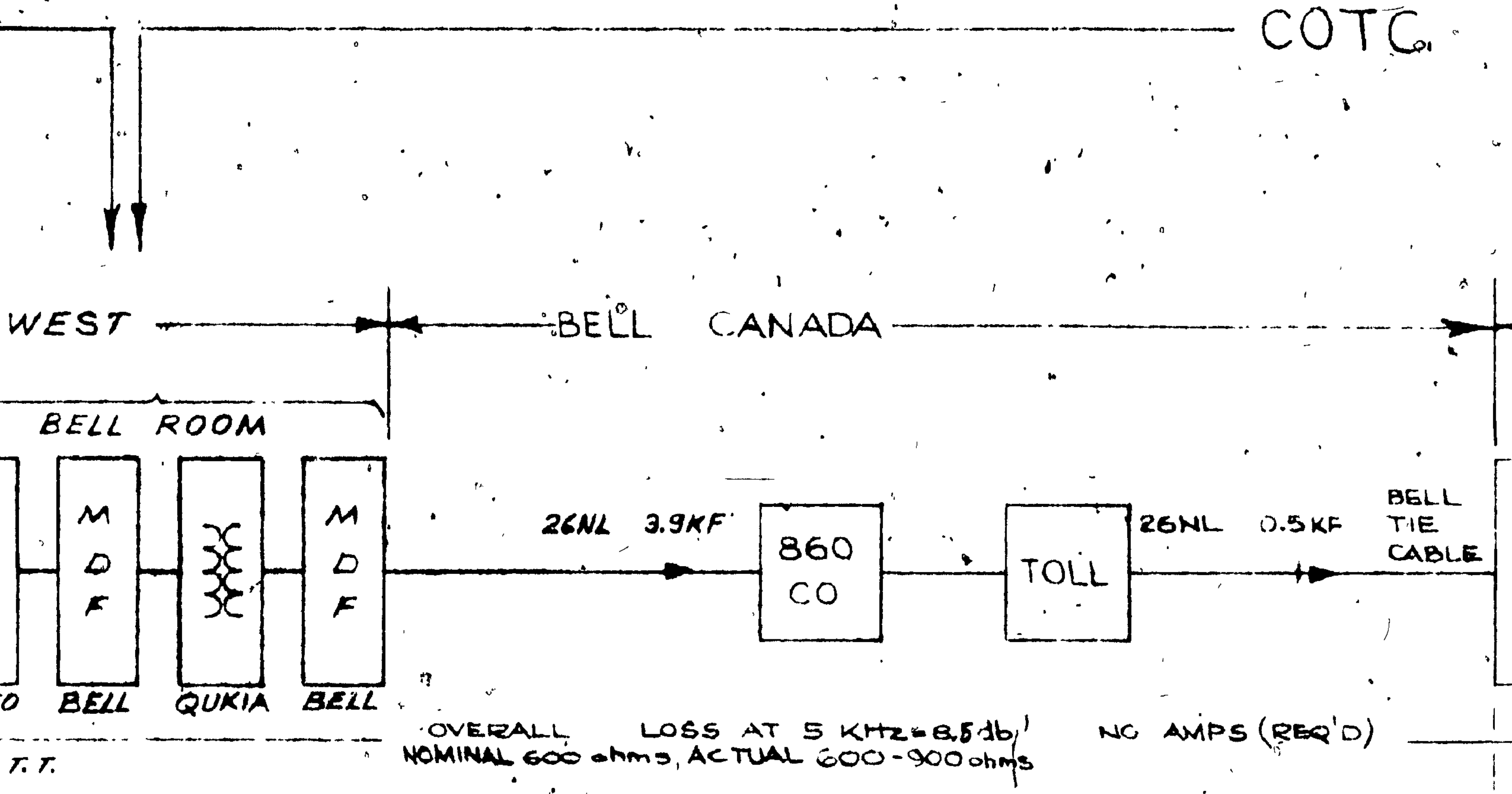
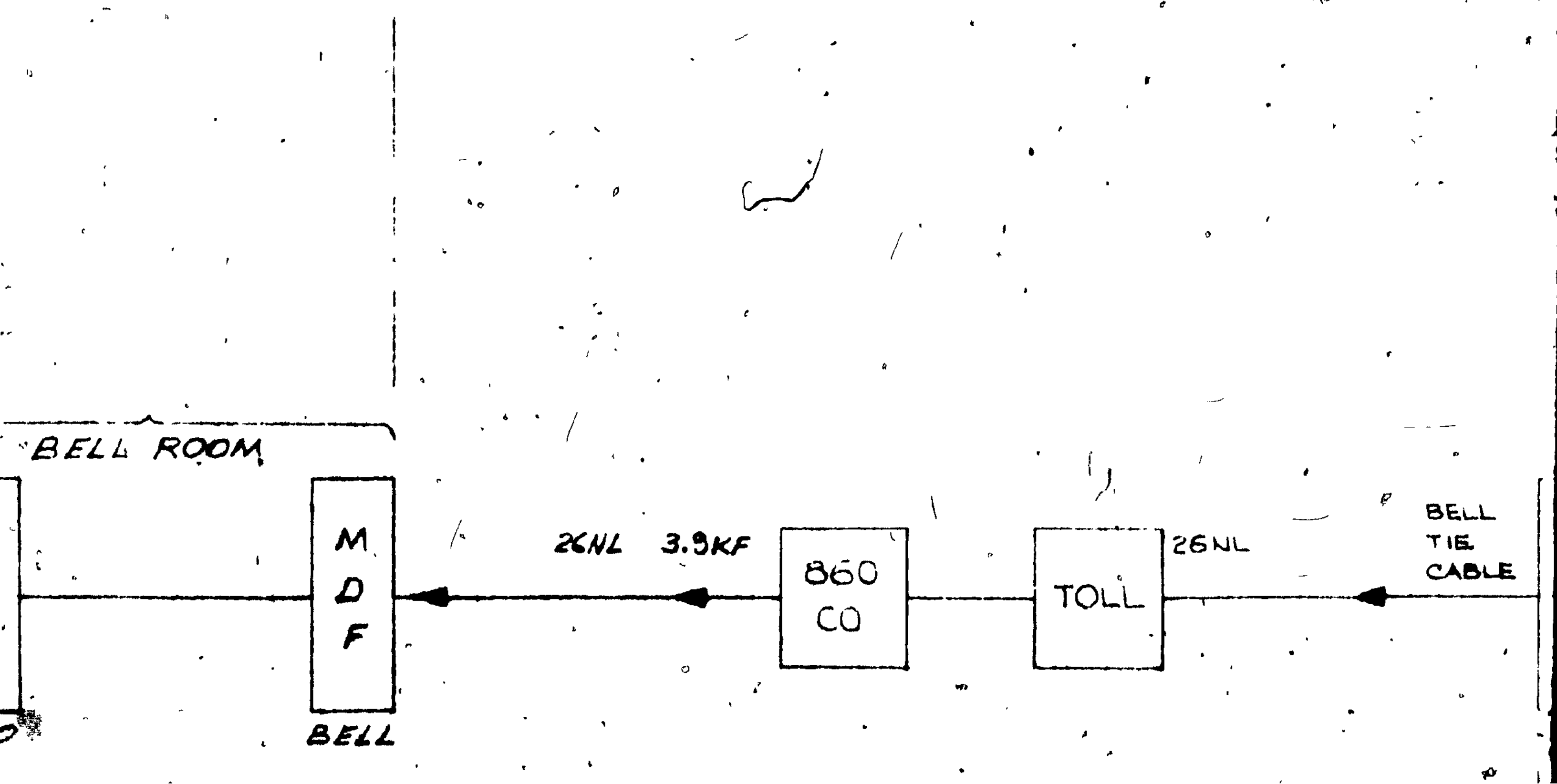
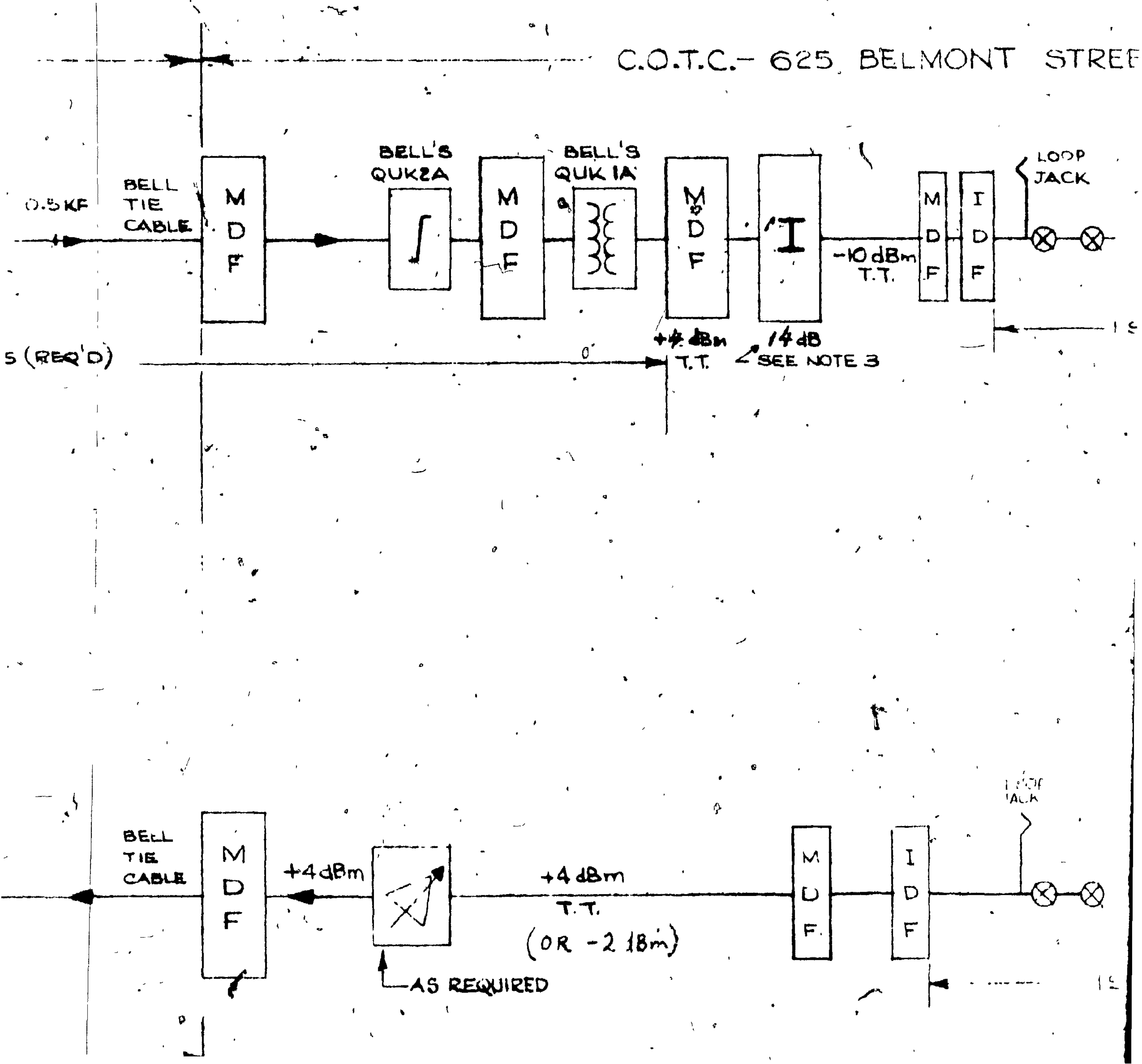


FIG. A- SEND, 5 KHz, 225 PAIRS

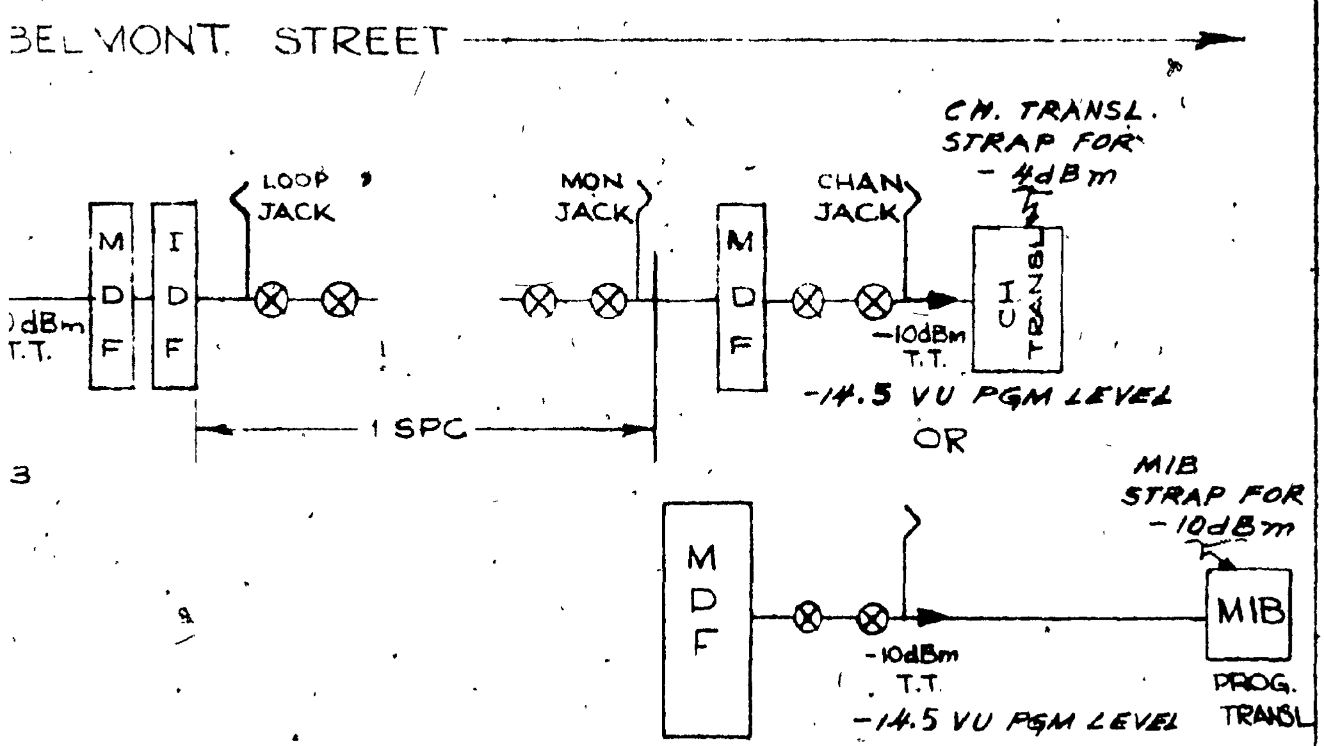


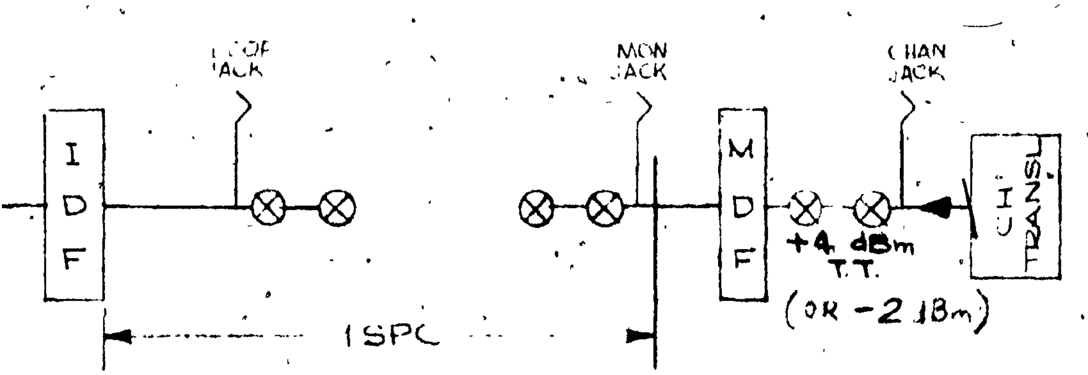
COTC CONTROL

3 of



4 of





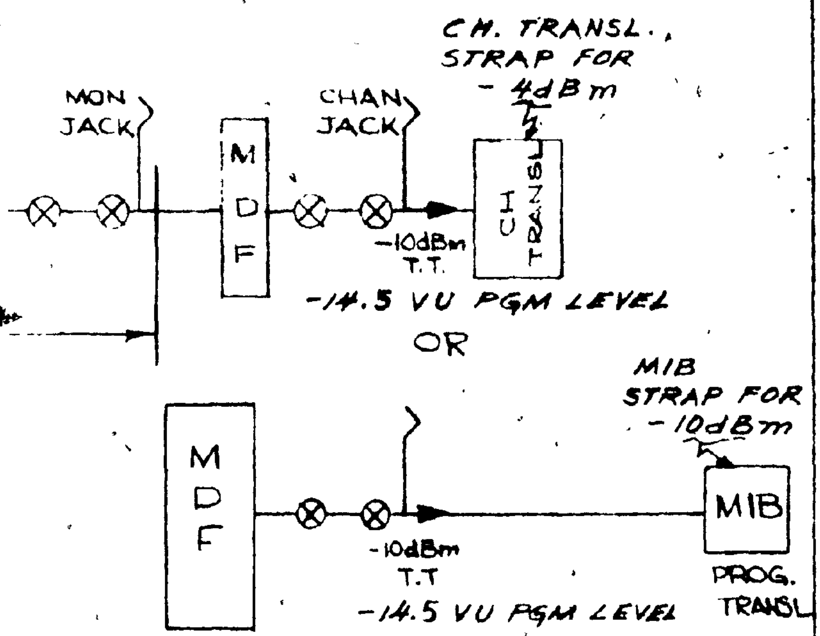
NOTES —

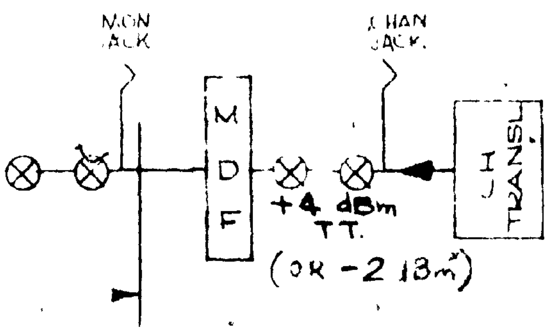
1) TEST TONE (T.T.
ACCORDANCE WI
BOOK (1972) VOL
i.e. PADDED DO
ENTERING CHAN
EQMT.

2) TEST TONE F
OR 800 Hz O
AND DOMESTIC S

3) NOMINAL FIX
REQUIRED 31
(i.e IN 0.5 db

4) STANDARD P
ON ORTO VU
ARE PADDED
THEREFORE
SIGNAL IS
THAN READIN





NOTES—

1) TEST TONE (T.T.) LEVELS ARE (?) [illegible] ACCORDANCE WITH C.C.I.T.T. [illegible] BOOK (1972) VOL. IV.1 REC. [illegible] i.e. PADDED DOWN 6dB BEFORE ENTERING CHANNEL TRANSLATING EQMT.

2) TEST TONE FREQ. = 1.0 kHz OR 800 Hz ON INTERNATIONAL AND DOMESTIC SIDE.

3) NOMINAL FIXED OR AS REQUIRED 31.5 db VARIABLE (i.e IN 0.5 db STEPS)

4) STANDARD PGM LEVEL = 0VU ON ORTO VU METERS, WHICH ARE PADDED BY 8db THEREFORE ACTUAL LEVEL OF SIGNAL IS 8db HIGHER THAN READING, OR +8VU.

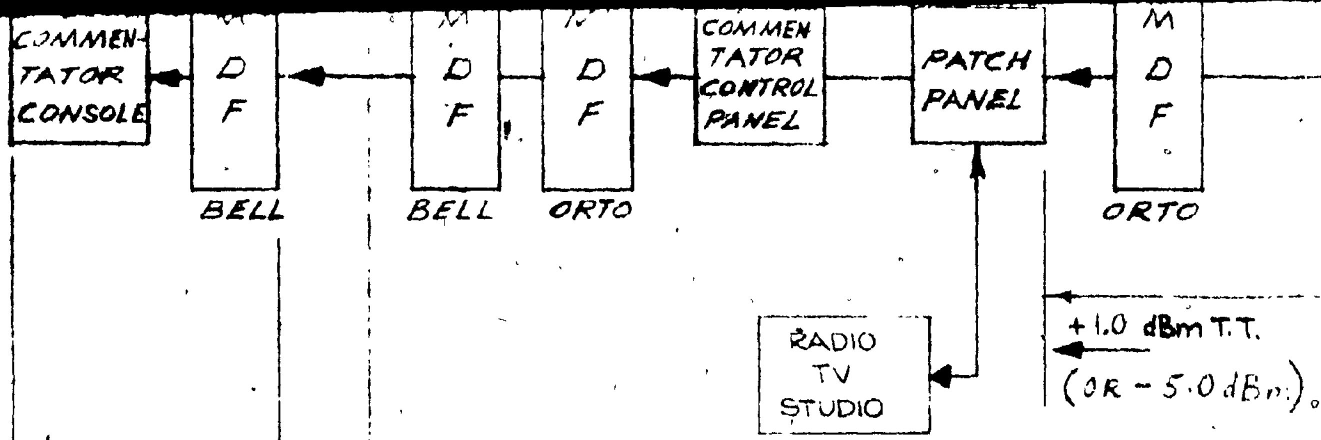


FIG.

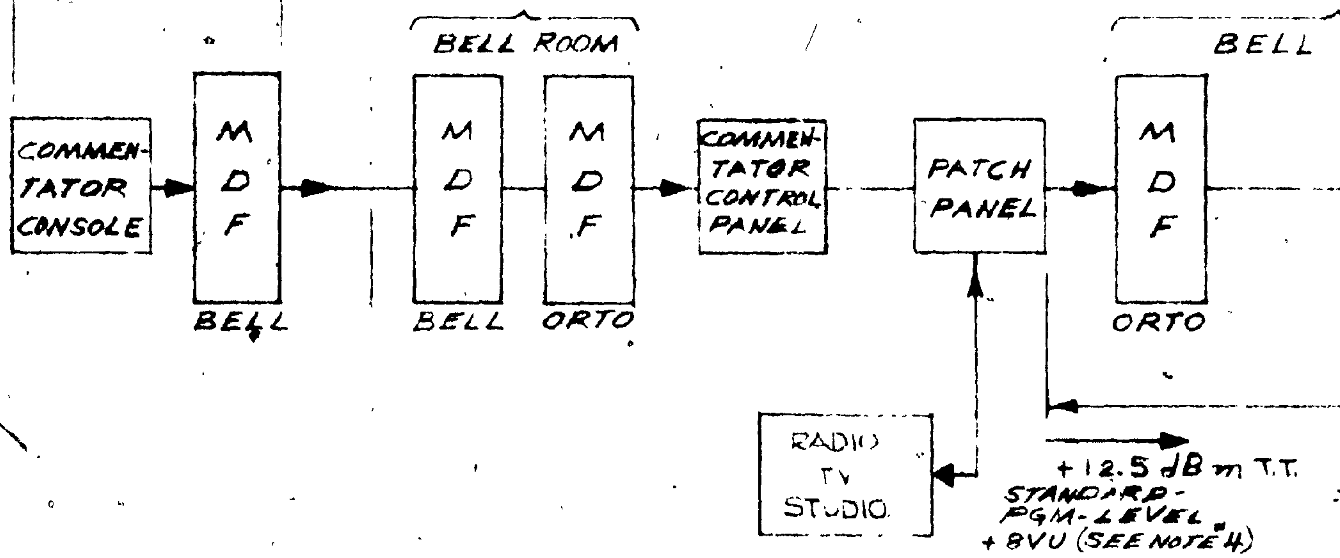
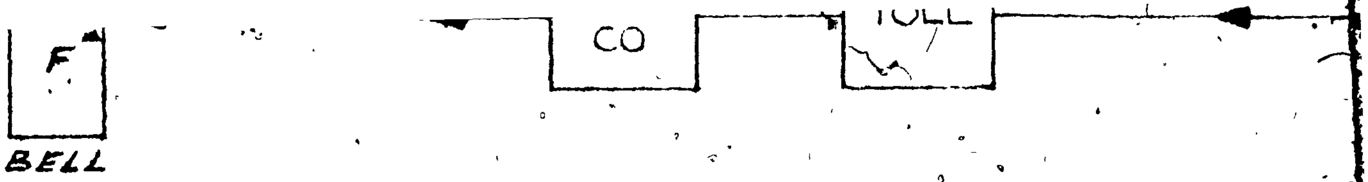


FIG.

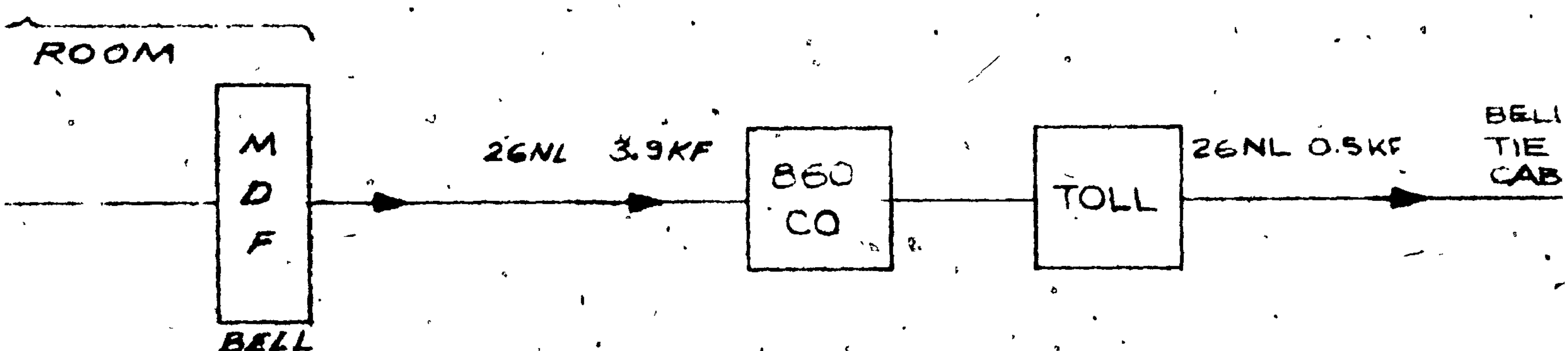
6 of

No.	AMENDMENTS
1	6-1-75 MC
2	GENERAL REVISIONS & NOTE 1 CHANGED 14-1-75.
3	GENERAL REVISIONS JAN-30-75
4	GENERAL REVISION 10-3-75 P.S.S.
5	FIG.A No. OF PAIRS REVISED 15-4-75 MC
6	ADD'N OF RADIO-TV STUDIOS, NOTE 3, IDF'S AND CONTROL BLOCKS, LEVEL RATIONALIZATION 25-6-75 MC
7	IDF'S NEAR CHAN TOW. DELETED WORD, CHANGED IN NOTE 2, ARROWS ADDED RADIO-TV STUDIO, ORTO CONTROL 1-12-75
8	FIG. A & C LEVELS REVISED AND NOTE 4 ADDED FEB-11-76



OVERALL LOSS AT 1KHz = 3.0db.
NOMINAL 600 ohms, ACTUAL 600-900 ohms

FIG. B-RECEIVE, 2.7KHz, 250 PAIRS

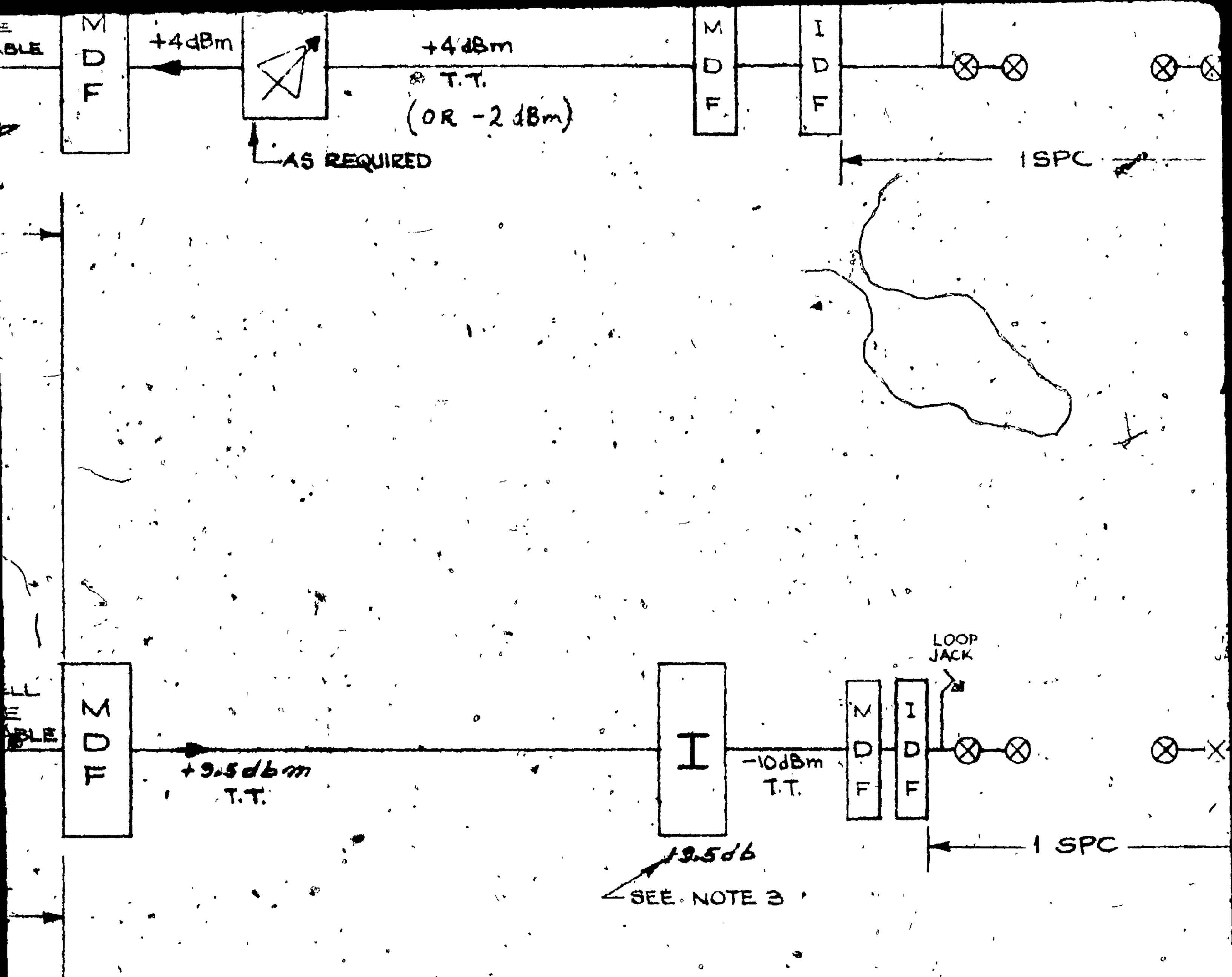


OVERALL LOSS AT 1KHz = 3.0 db
NOMINAL 600 ohms, ACTUAL 600-900 ohms

FIG. C-SEND 2.7KHz, 250 PAIRS

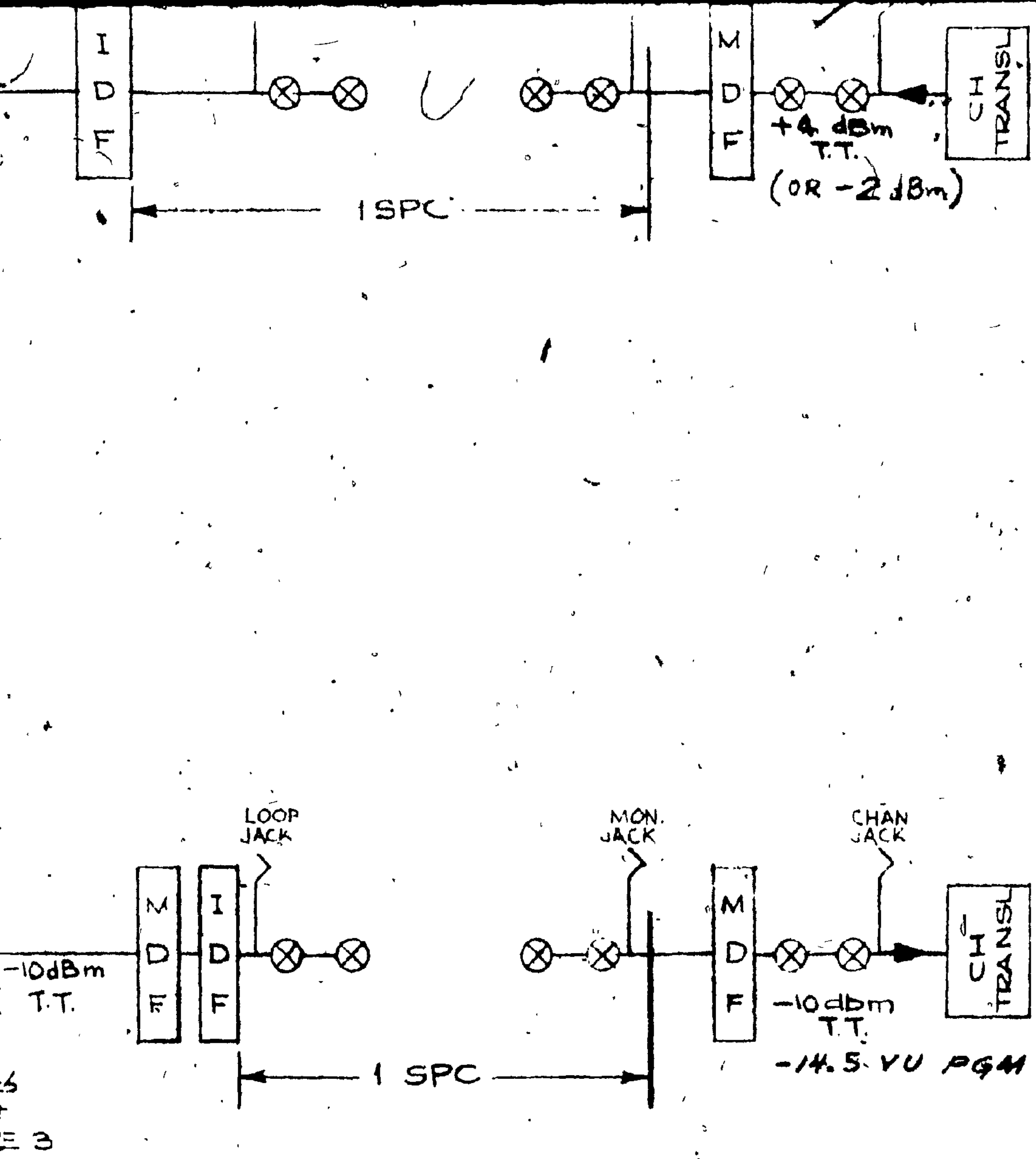
CONF

4 of



FIDENTIAL

8 of

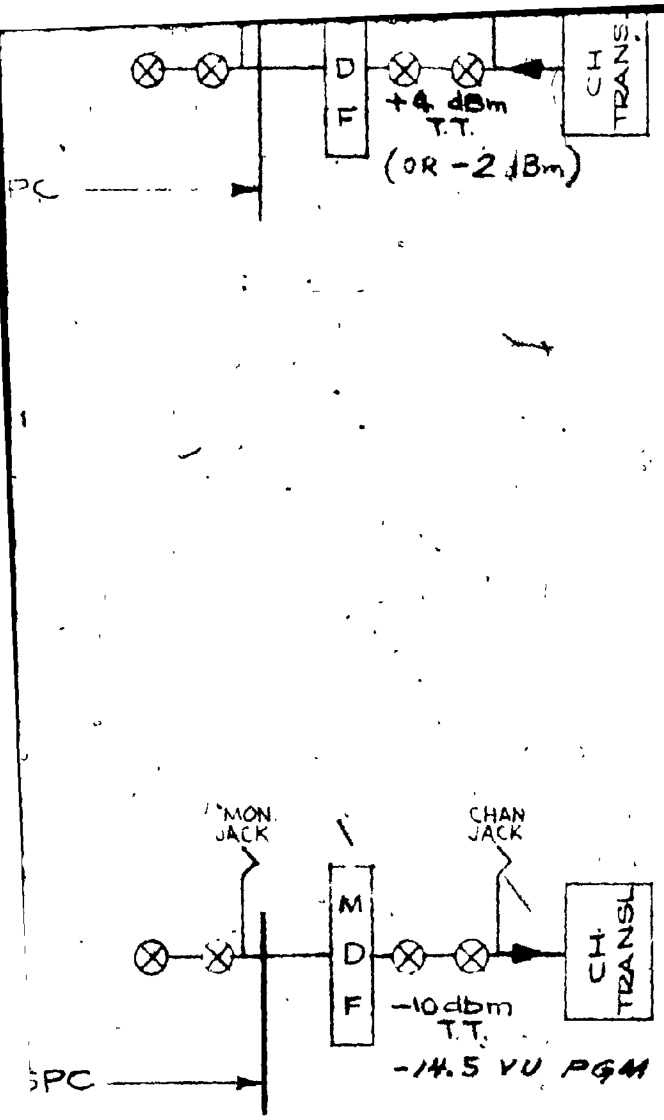


CONFIDENTIAL

9 of

DRAWN MC	CANADIA… TELECOMMUNICA…
PREPARED	PROPOSE…
VERIFIED	SCHEMAT…
SUBMITTED	COMMSEC 7…
APPROVED	SCALE

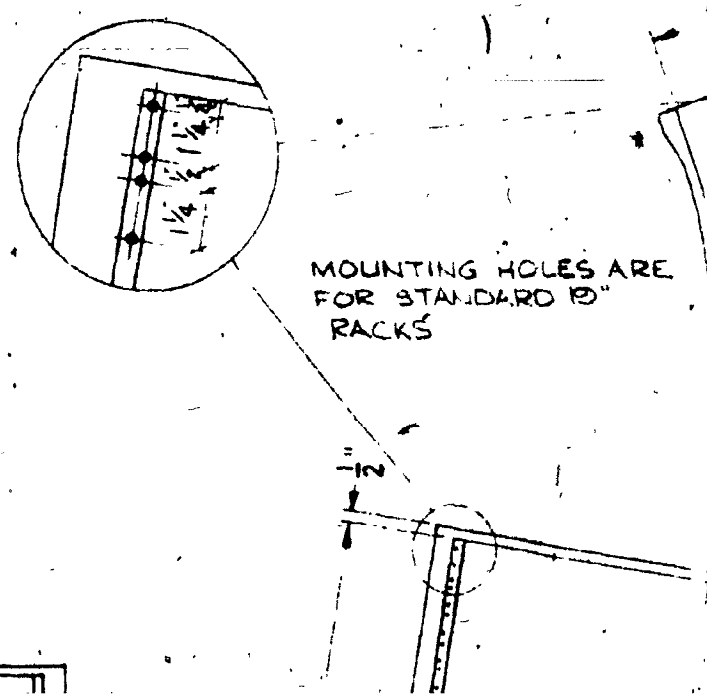
DWG. BP5/D/4.3/



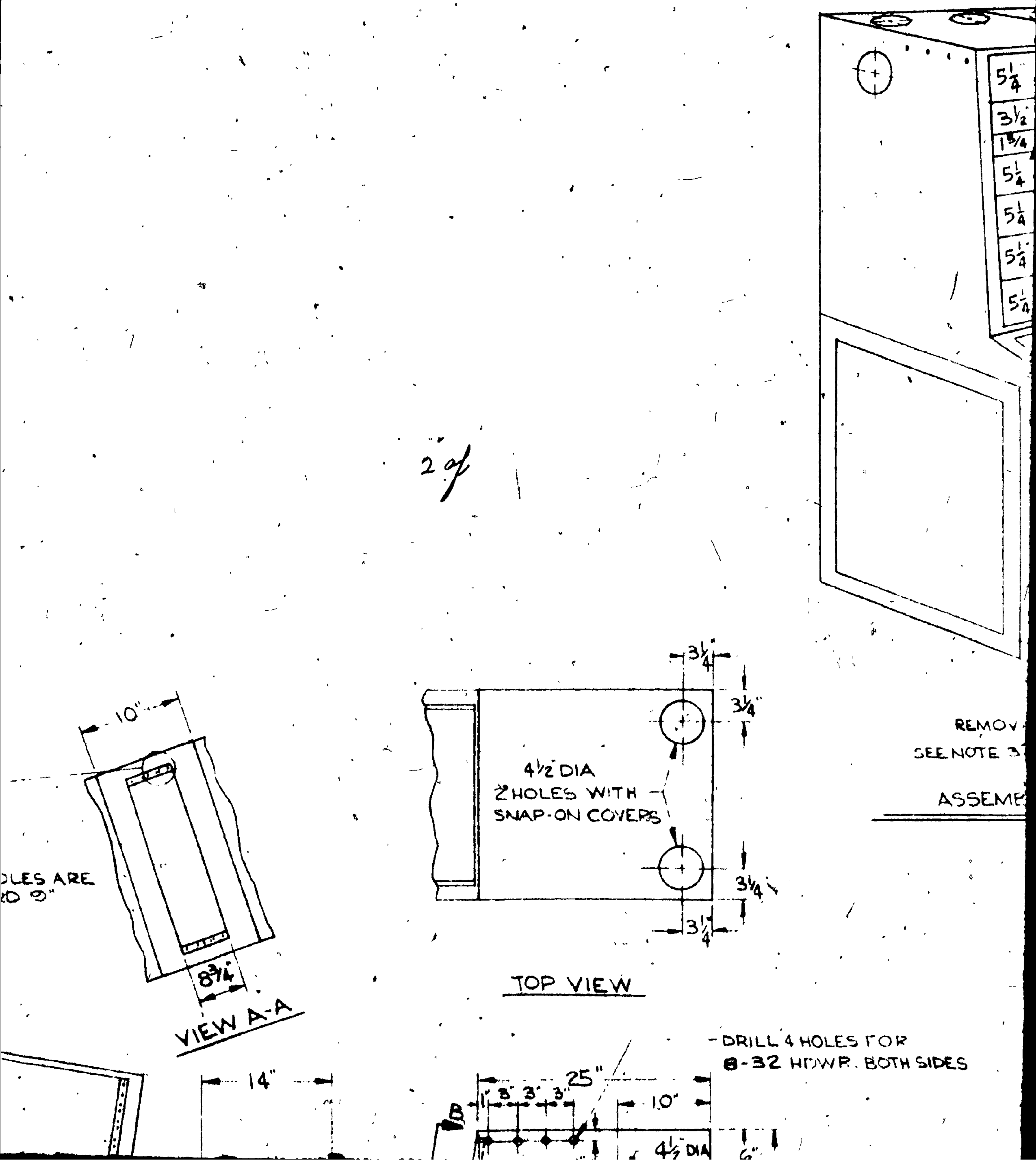
10 of 10

CONFIDENTIAL

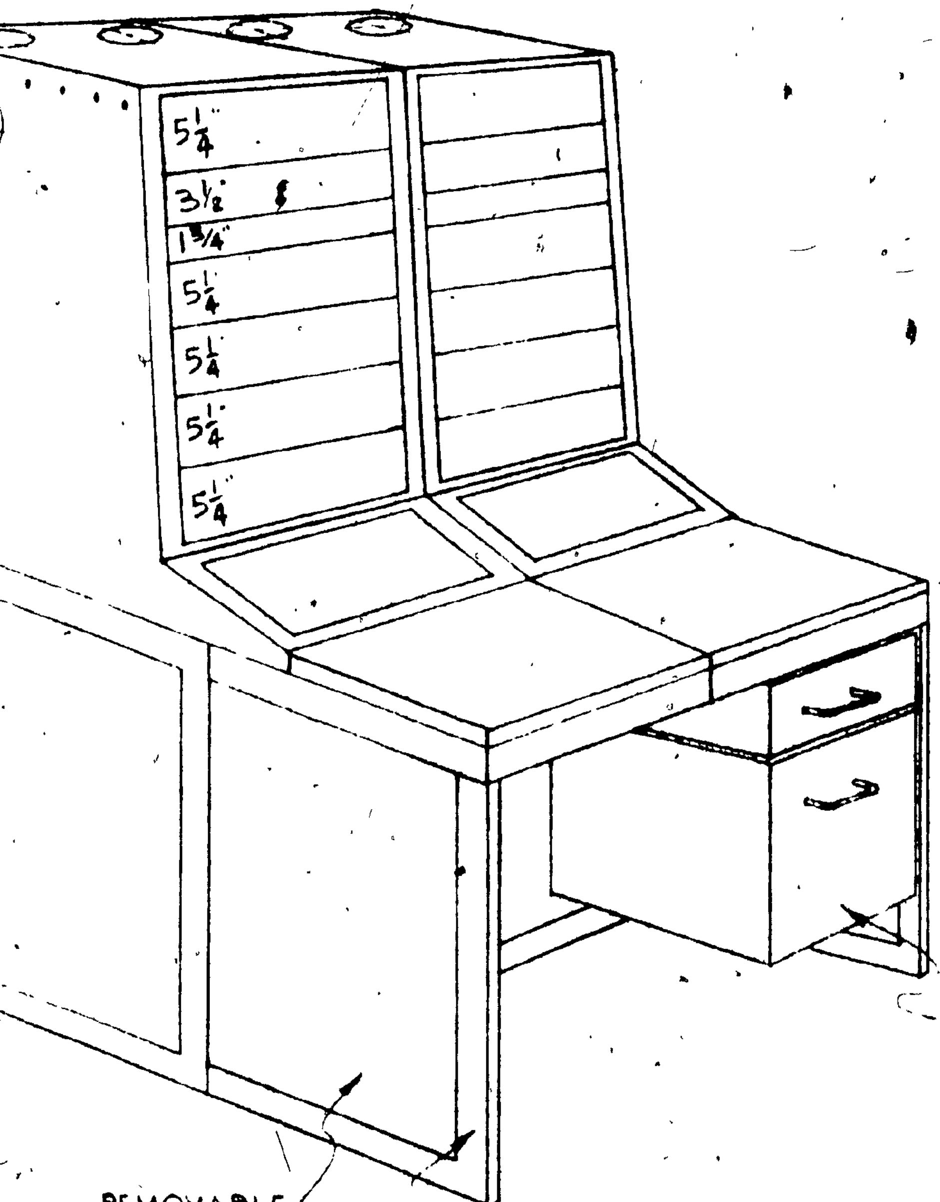
DRAWN Mc	CANADIAN OVERSEAS TELECOMMUNICATION CORPORATION
PREPARED [signature]	PROPOSED AUDIO SCHEMATIC FOR COMMSEC 76 (MONTREAL)
VERIFIED [signature]	
SUBMITTED [signature]	
APPROVED [signature]	SCALE
DWG. BP5/D/4.B/1	SHEET 1 OF 1


MOUNTING HOLES ARE
FOR STANDARD 19"
RACKS

2 of


5 1/4
3 1/2
1 3/4
5 1/4
5 1/4
5 1/4
5 1/4
REMOV
SEE NOTE 3
ASSEMB
3 1/4
3 1/4
4 1/2 DIA
2 HOLES WITH
SNAP-ON COVERS
3 1/4
3 1/4
TOP VIEW
10"
8 3/4
VIEW A-A
LES ARE
D 9"
DRILL 4 HOLES FOR
8-32 HDWR. BOTH SIDES
14"
25"
1" 3" 3" 3"
10"
B
4 1/2 DIA
6"

3 of

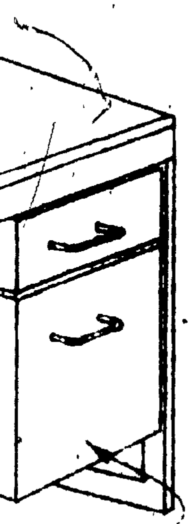


ALL BAYS TO BE SUPPLIED WITH PROVISION
FOR TWO DRAWERS (REMOVABLE)
SEE NOTES 3 & 4.

REMOVABLE
SEE NOTE 3 & 4

ASSEMBLY - 2 BAYS

R
TH-SIDES



ALL BAYS TO BE SUPPLIED WITH PROVISION
FOR TWO DRAWERS (REMOVABLE)
SEE NOTES 3 & 4.

NO

1.

2.

3.

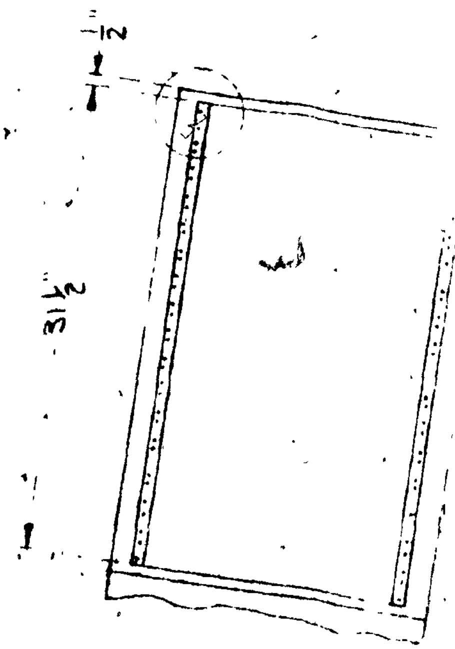
4.

NOTES -

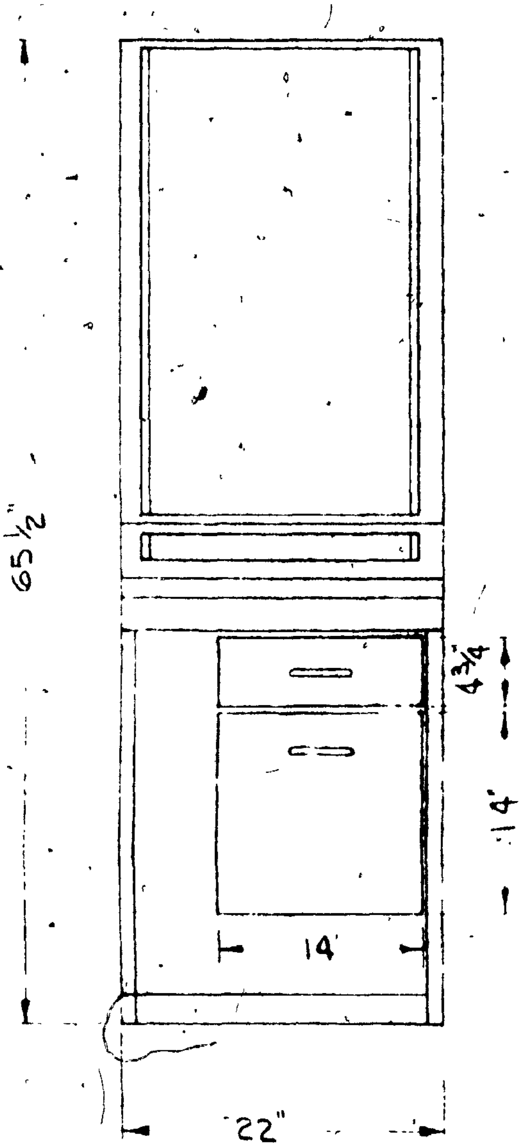
1. DRAWING BASED ON CONSOLE MANUFACTURED BY COMPUTER METAL REG'D.
   FOR DETAILED DIMENSIONS SEE COMPUTER METAL SPEC. C-1403
2. THE WRITING DESK SURFACE SHOULD BE ARBORITE.
3. CONSOLES WITHOUT DRAWERS DO NOT NEED SIDE PANELS & THEIR SUPPORT BRACKETS UNDER WRITING DESK.
4. CONSOLES ORDERED WITH DRAWERS NEED SIDE PANELS & SUPPORTS ON THE RIGHT HAND SIDE ONLY.
   LEFT HAND SIDE TO BE LEFT TO MATCH WITH ADJACENT CONSOLE AS IN NOTE 3.

VISION

5 af



VIEW B B



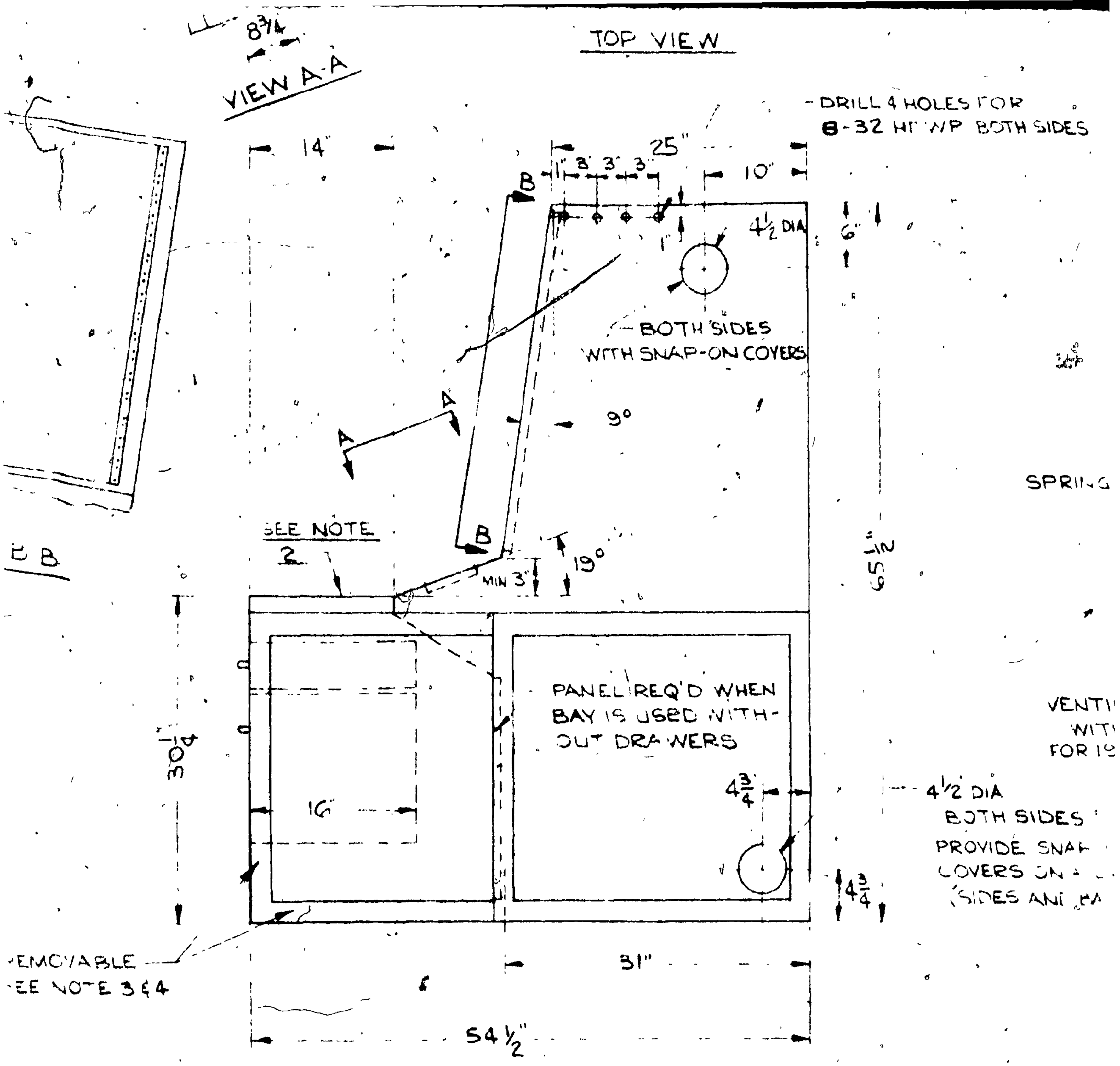
BOTH DRAWERS REMOVABLE

REMOVABLE SEE NOTE 3

FRONT VIEW

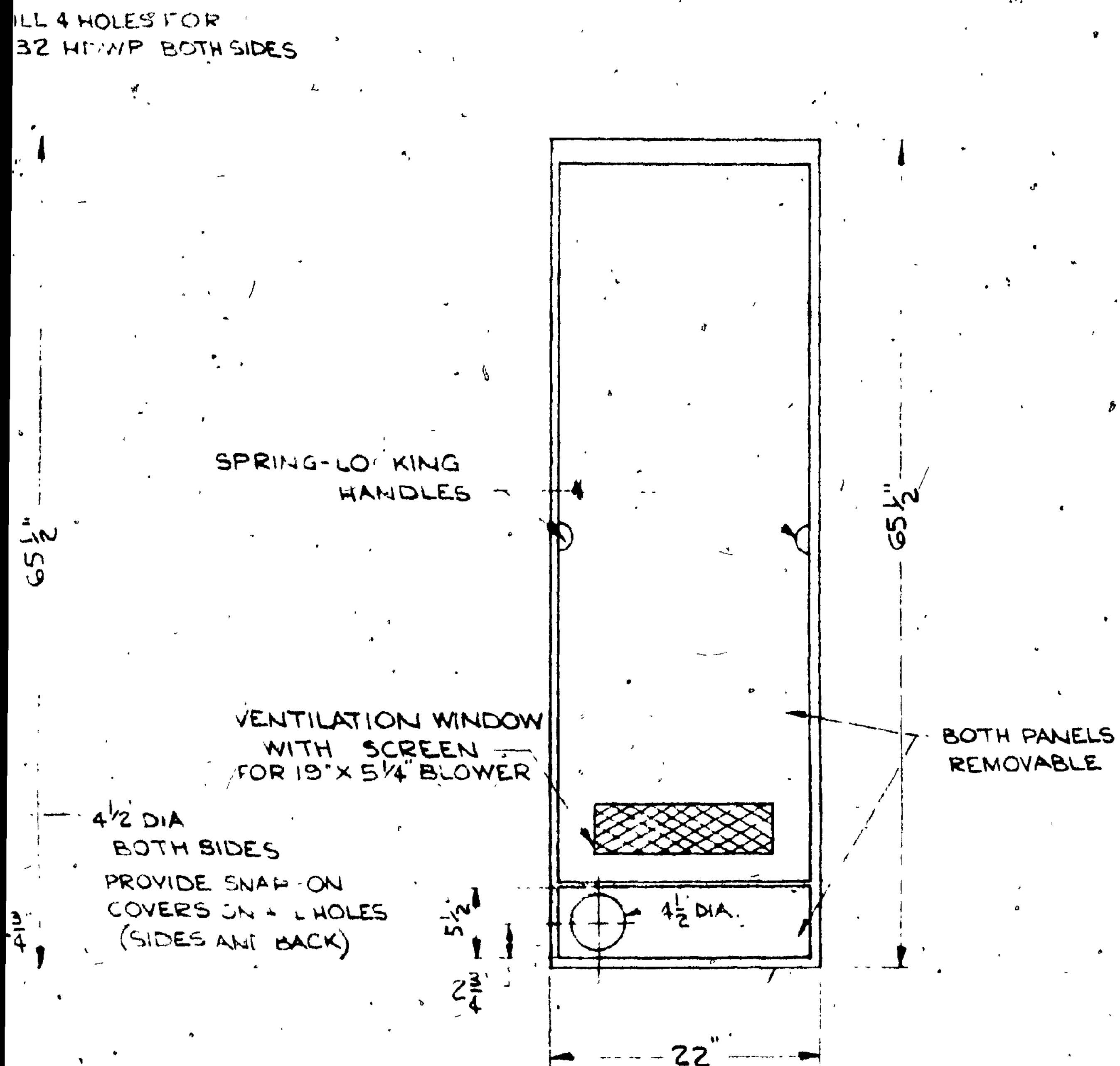
6 of

ISSUE No	AMENDMENTS	
1	14-3-75	P.J.S.



RIGHT SIDE VIEW

4 of



REAR VIEW

8 of

FINISH. PAINT CO
(NORTHER
No.15 RECO
WILLIAMS
INDUSTRI

PANELS
OVABLE

TOLERANCES:- HO
±

INGÉNIEUR · ENGINEER
Aristides H. Maccrakis
27506
QUÉBEC

9 of 1

DRAWN P.J.S.	· CA
PREPARED A.M.	TELECOMM
VERIFIED	MONTREAL
SUBMITTED A.M.	CONSOL
APPROVED	S
	SCALE 1" = 1'-0

DWG. BP43/ D/

FINISH PAINT COLOUR TO BE IVORY (NORTHERN ELECTRIC #1871) THIS No. IS RECOGNIZED BY SHERWIN-WILLIAMS & CANADIAN-PITTSBURG INDUSTRIES.

TOLERANCES: HOLES & HOLE CENTERS AT ± 1/64, OTHERS AT ± 1/32

10 of 10

DRAWN P.J.S.	CANADIAN OVERSEAS TELECOMMUNICATION CORPORATION
PREPARED A.M.	MONTREAL O'SEAS TERMINAL CONSOLE MANUFACTURING SPECIFICATIONS
VERIFIED	
SUBMITTED A.M.	
APPROVED	SCALE 1" = 1'-0"
DWG. BP43/D/1.3/1	SHEET 1 OF 1