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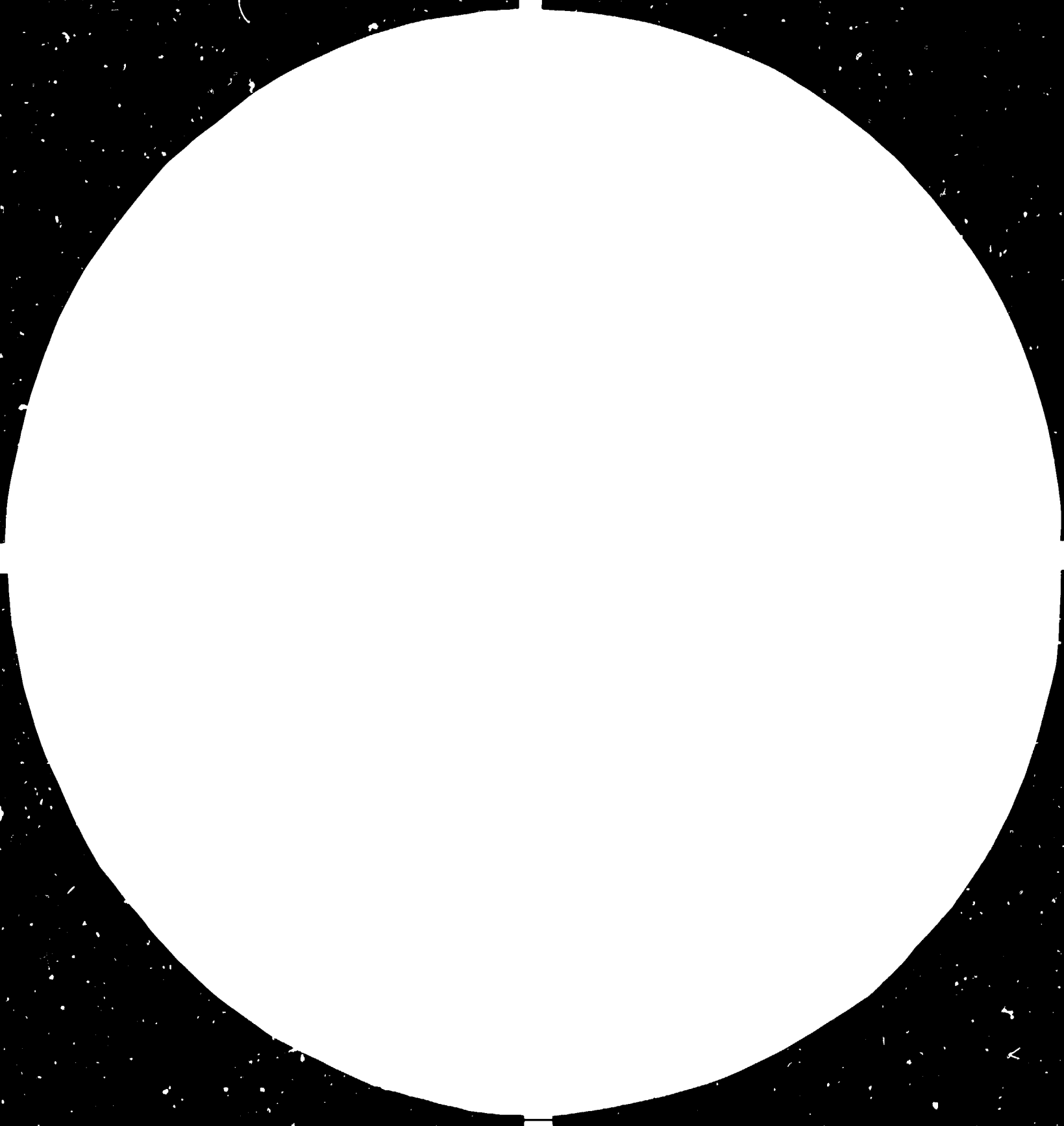


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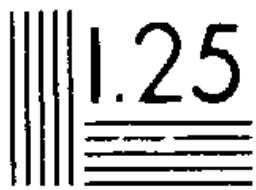
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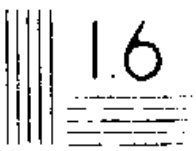
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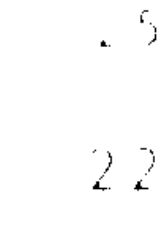
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DP/ID/SER.B/450
30 March 1984
ENGLISH

China

TECHNICAL ASSISTANCE TO THE ELECTRONICS INDUSTRY: TV FACTORY

SI/CPR/80/805

PEOPLE'S REPUBLIC OF CHINA

Terminal report *

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

by Harry L. Swaluw, Consultant in the design of TV sets

United Nations Industrial Development Organization
Vienna

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CONTENTS

ABSTRACT

This report deals with the implementation of the project CONSULTANCY IN MANUFACTURE OF TV SETS SI/CPR/80/805/11-01/31.9.C. PEOPLE'S REPUBLIC OF CHINA.

One expert has already spent three months at the factory assisting management in improving the design of a new CTV receiver.

The existing CTV design (prototype) has been evaluated and advice has been given how to improve its performance. The work consisted of a practical part and tuned to this, a theoretical basic training.

Modern techniques, such as IC architecture and mains separated supplies were discussed.

The project was concluded by a Seminar that was attended by a number of TV designers from all over China.

The author strongly recommends intensive training in the English language (written and spoken).

INTRODUCTION

The project to be described in this document is one contained in a list of sixteen proposals submitted to UNIDO by the Chinese Authorities after a Programming Mission had visited the People's Republic of China in July 1979.

These proposals deal with technical assistance to the Electronics Industry and to the TV industry in particular.

This report describes the assistance given in the field of CTV design at the Shijiazhuang Television Factory.

The expert has effectuated the design-part of project SI/CPR 80/805. The quality-part of the same project has been realized in 1980. The project herewith is completed.

I Factory Data and Background

With a personnel component of 1,100, the Shijiazhuang TV factory produces B/W television sets under complete assembly conditions and CTV receivers under SKD (semi-knocked down) conditions. The yearly output is 70,000 B/W sets and 30,000 CTV receivers. The organizational structure of the factory as well as the personnel breakdown is given in the next two pages.

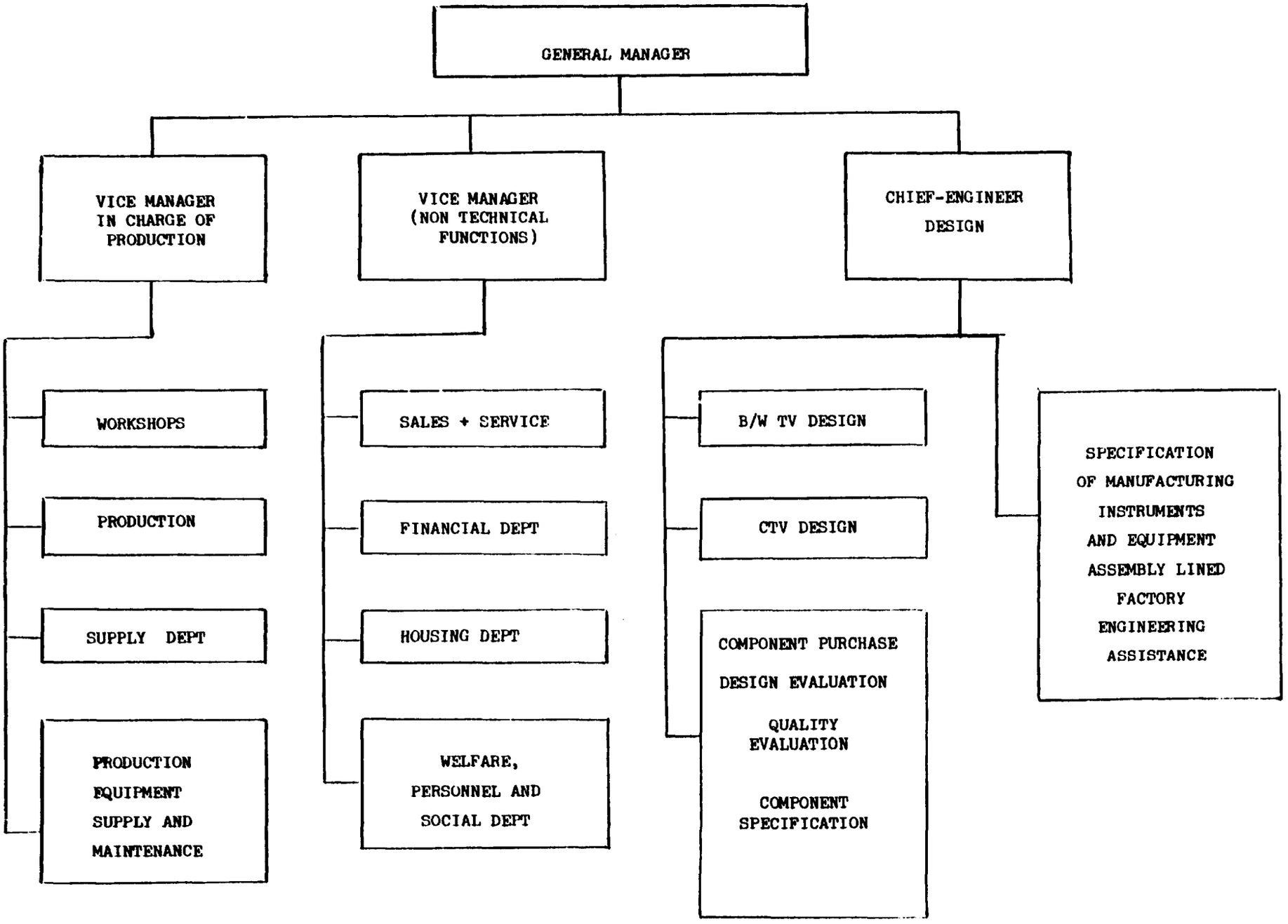
II Objective and Topic of Project

a) To assist the CTV design engineers in evaluating their first locally-designed CTV.

b) To assist the CTV design engineers in up-dating their theoretical and practical CTV knowledge.

c) To recommend desirable modifications in the present CTV design.

d) To introduce the CTV design engineers to the latest trends in component design and specifications, as well as in the applications of these components.


GENERAL MANAGER
VICE MANAGER IN CHARGE OF PRODUCTION
VICE MANAGER (NON TECHNICAL FUNCTIONS)
CHIEF-ENGINEER DESIGN
WORKSHOPS
PRODUCTION
SUPPLY DEPT
PRODUCTION EQUIPMENT SUPPLY AND MAINTENANCE
SALES + SERVICE
FINANCIAL DEPT
HOUSING DEPT
WELFARE, PERSONNEL AND SOCIAL DEPT
B/W TV DESIGN
CTV DESIGN
COMPONENT PURCHASE
DESIGN EVALUATION
QUALITY EVALUATION
COMPONENT SPECIFICATION
SPECIFICATION OF MANUFACTURING INSTRUMENTS AND EQUIPMENT ASSEMBLY LINED FACTORY ENGINEERING ASSISTANCE

The personnel establishment of the Shijiazhuang TV factory

Actual personnel total	1109
of which male	578
and female	531

Personnel sectionalized

Engineering	137
Design	
B/W TV	13
CTV	5
Mechanical	10
Manager's office	17
Quality control dept.	45
Financial dept.	16
Personnel dept.	6
Production planning dept.	7
Supply dept.	35
Sales dept.	51
Equipment dept.	54
Tools dept.	43
Chief engineer's office	26
Design assistance dept.	38
Education dept.	6
Welfare dept.	31
Instrument dept.	41
Building dept.	19
Subtotal	600

Subtotal I	600
Workshop I (Injection mould)	51
Workshop 2 (Trial Prod. Line)	99
Workshop 3) Workshop 4) (B/W assembly lines)	145
Workshop 5 (CTV assembly line)	59
Workshop 6 (Receiver inspection and soak test)	61
Various funtions	94
Total	1,109

III Activities carried out, outputs produced

a) General introduction

The main part of the activities for this mission were concerned with effective assistance to the design and design considerations of a colour TV set to be manufactured at the Shijiazhuang Television Factory.

In order to provide a balanced report it is useful to briefly recall the actual development which had taken place in a TV design laboratory such as the one at Shijiazhuang.

b) Historical background

During the developing years of Radio and TV a true revolution in component design took place.

Until 1960, most sets were equipped with (costly) valves or tubes. The number of design variations was limited by cost considerations and the design by itself was therefore relatively simple. Larger TV factories produced their own valves and components. Due to the heat generated by the valves, reliability was poor.

About 1950 the transistor appeared. This component could replace electronic valves, generated much less heat but was itself rather sensitive to overheating. Initially, only small type transistors were available. The so called power functions in Radio/TV sets still required valve or tube complements.

This led to a hybrid design (transistors and tubes) with high working temperatures due to the tubes which also limited reliability.

The third stage started about 1970 with all transistor designs since power transistors now became widely available. Design complexity of course increased with the introduction of CTV with its many more functions.

Certain TV manufacturers made available their components to the so called setmakers; application information was also supplied

To realize his design, the setmaker would have a design laboratory with skilled engineers and would keep in touch with his supplier also on matters such as evaluation of design (field service) and updating for future development trends.

Shortly after 1970 so called integrated circuits became available. (IC's are complete circuits, reproduced in micro structure by photographic and chemical means, and by diffusion techniques). IC's comprise diodes, transistors, resistances, capacitors plus the associated wiring.

Because the dimensions of a simple transistor had become so minute in this technique, one so called IC could contain several hundreds of components and the associated circuitry became more and more sophisticated. Discrete components moved gradually with their functions inside IC's. Wiring and internal components required for interconnecting IC's are called periphery. Today's situation (1983-84) shows a tendency to compress the necessary CTV circuitry into as few IC's as possible.

This leads to very complex IC's performing still many more functions each. Today's industry has one so called B/W TV IC available, performing all required small signal functions between the tuner and the video, deflection and sound output stages. A complementary integrated circuit for CTV is available also.

c) The actual situation

The actual art of designing TV and CTV in the setmaker business thus comes down to a well balanced choice of the main components, in fact the IC selection. Within the given possibilities as many of the required electronic functions as possible should be realized by IC's instead of by discrete element circuitry. The IC solution will, besides being more harmonic (this means fitting more neatly in the interface circuitry) almost certainly give a better MTBF (mean time between failures) performance than a hybrid solution comprising extra semiconductor circuitry. It was in the light of this philosophy that the Shijiazhuang design Mk2 has been evaluated.

d) The technical part of the visit

The original 1980 plan consisted of assistance with the design of a CTV set. A design now, however, existed and there were a number of questions.

The original plan therefore was readjusted, the author being of the opinion that it was also desirable to give the laboratory people some additional basic know-how as well as specific training on modern components and their applications.

Besides the theoretical design instruction a practical training was also given, accompanied by measurements.

The order and choice of the treated subjects was defined by the laboratory. Wherever needed, this order would be interrupted for discussing design problems with high priority, equally presented by the laboratory.

Each subject was, if possible, accompanied by relevant measurements in the Mk2 model.

From this, rather drastic advice followed with respect to the so-called switched mode power supply sections and with respect to the combined control functions as contrast, brightness, saturation. It was recommended to use different types of IC's. Suitable substituting components were proposed and discussed. Samples are on their way to the factory and probably have arrived by the time this report is printed. The treated subjects are given next in detail and chronological order.

e) Special seminars

The author was also requested by the Ministry of Electronics Industry at Beijung, to prepare and give a 9-day technical seminar to a selection of CTV design engineers from all over China. The subjects for these lectures were largely contributed by the audience, thus having sent in beforehand specific technical questions.

The author added some subjects to complete the seminar programme.

There were 26 visitors from abroad in a total audience of 65-75. The programme items are given below. There was much interest in recent large-scale IC's. The seminar, which was held in a classroom of the Teachers' University rounded off the author's stay in Shijiazhuang.

IV Programme of theoretical and practical subjects, treated at the Shijiazhuang TV Factory

a) The (PSM) Parallel Switched Mode Power Supply

Functioning of PSM circuits.

Design of PSM circuit details and of PSM transformer.

Measurements in Mk2 model.

Recording of oscillograms and discussion.

Check of Mk2 power consumption.

Mains separation.

Constant and variable switching frequency operation and the related mains voltage stabilizing range.

The control loop.

Interferences, screening, measurement method with pick-up loop.

Suppression measures.

Functioning of the transistor switch: junction discharge.

Safety circuit + over-voltage and over-current.

b) The SSM Series Switched Mode Power supply

Functioning, control chracteristics, SSM coil design.

c) IF amplification and detection of composite video

Analysis of semi single sideband reception.

Distortion types caused by amplitude defection.

Quadrature cross talk effects; the Nyquist flank and its requirements.

The SAW Surface Accoustic Wave IF filter and its specifications.

Practical SAW bandpass measurement in the Mk2 model.

Calculation of measuring error produced by damped synchronous detector.

Temperature effects.

d) Synchronous Demodulation

Principle of switching (synchronous) demodulator with Fourier analysis.

Square Wave approach.

Requirements of reference circuit.

Automatic gain control (AGC); delayed AGC.

Automatic frequency control: the AFC Synchronous detector.

Measurements in the Mk2 AFC section.

Detailed discussion and lecturing on 7607 type IF integrated circuit (Mk2), inclusive black-and-white noise protection.

Evidence of elimination of intermodulation products in synchronous detection, resulting in picture quality improvement.

e) Group Delay Theory

Analysis of group delay errors.

The Shiba Shoku G.D. measuring equipment; lecturing and practical delay measurements in the Mk2 video amplifier.

Evaluation of results.

Practical confirmation of theoretical analysis.

Relation between video and r.f. group delay errors.

Design of extention delay measuring circuitry, thus adapting the Shiba Shoku instrument to perform all over IF and RF measurements.

Adaptation of AGC time constants to Shiba Shoku measuring time cycle.

Evaluation of results.

f) Adaptation of Reference Circuit for B/W reception.

Consequences for white interference effects and for quadrature rejection.

g) Investigation of locally produced B/W receiver type, in order to trace instability phenomena.

Practical measurements in screened R.F. cage.

Defect localized to radiating reference circuit and double reference frequency in video detector output signal.

Remedy proposed consists of improved component screening as well as filtering of video detector output signal.

h] The control functions and their interdependency

Evaluation and measurement of the Mk2 model contrast-, brightness-, and colour control functioning.

It was considered advisable to modify the discrete video-component circuitry of the Mk2 into a suitable IC, thus considerably improving overall performance and picture quality.

Lectures on interdependency of these functions were given.

The internal organization of the proposed type of integrated circuit was explained and discussed, and emphasis was laid on the relation between the different controls, and on the subsequent signal processing.

Specifications of the proposed circuit were discussed in detail.

Basic property of clamping; discussion of various types of clamping circuits.

Linearization of control functions.

Beam current control acting via brightness vs contrast control functions.

i] The synchronizing functions; generation of vertical and horizontal drive signals.

Lectures on organization of modern sync + deflection drive IC.

Special attention for noise suppression and adaptation to VCR operation.

Specifications of modern IC.

Generation of so called sandcastle pulse, used for multiple purposes.

Use of double line frequency.

Phase discriminator for delay equalization of line output transistor.

Demonstration of phase relations between sync. flyback and drive voltages.

Explication of delay phenomena.

j) Deflection output stages

The line output stage:

Correction of raster (East-West) distortion by using desired vertical deflection signal.

Effect on EHT.

The diode-split EHT transformer.

EHT generation.

Secondary supply voltage generation by using horizontal scan and flyback rectification.

The vertical output stage:

Lectures on single ended push-pull output amplifier.

Effect of supply voltage on flyback duration.

Correlation with power consumption.

Measurements in Mk2 and evidence of flyback time increase with lowering of supply voltage.

k) Video output stages

The Mk2 single transistor stage.

Symmetry requirements for colour operation.

Gain requirements.

Effects of DC shift and gain variation on background colour and on reference white colour.

How to apply the tube manufacturer specification.

Lecture on CRT drive data.

Third degree characteristics.

Colour adjustment with white-D meter.

D.C. stability requirements of drive circuitry.

l) Colorimetry

- A complete resumé has been given to the laboratory with the specific aim of enabling the engineers to make a fair estimate of colour reproduction quality. The main topics discussed were:

- Physical nature of light, spectral distribution.
- Measurement of light.
- Additive and substractive mixing of colours.
- Tristimulus values $\bar{r}$, $\bar{g}$, $\bar{b}$.

- Trichromatic coefficients r, g, l.
- Construction of basic r, g, l colour triangle.
- Transformation leading to x, y, z colour triangle.
- Application of Grassman's Laws.
- Calculation of colour co-ordinates, x, y out of a given spectral energy distribution.
- Graphical addition of coloured lights.
- Colour differences and their percibility.
- The relation between the phosfor colours of the screen and the reproduced reference white colour. Colour temperature.
- Beam current drive ratio's and their effect on colour differences.
- Evolution of reference white colours.

m) <u>The Composite Video Colour signal</u>

- The initial choice of screen phosfor colour points.
- Reduced bandwidth for colouring information.
- Balanced modulation for colour difference signals.
- Application of principle of quadrature modulation.
- Choice of subcarrier frequency.
- The NTSC colour standard.
- Colour crosstalk effects in NTSC.
- The PAL colour system. Elimination of NTSC defects.
- The PAL spcification.
- Decoding of PAL colour signals. IC realization.
- The ultrasonic PAL delay line. Measurements in the Mk2 receiver. Comparison of several Chinese PAL delay lines.

n) <u>Remote Control</u>

- Principle of digital coding.
- Specification of controllable functions.
- The latch function.
- The infrared transmitter.
- Digital to analog conversation.
- Display circuitry and visual displays.

o) Sundry

As an illustration of the presented theory, the lectures were concluded with the discussions of a relatively recent CTV model from Western Europe.

V The Seminar given at the request of the Bureau of Radio and TV Industry of the Ministry of Electronic Industry (BEIJING)

General

From the Ministry a number of subjects (sent in by the audience) were received beforehand. These subjects made up the base of the seminar programme. The audience proved much interested in quite recent IC's, and in their specifications and applications.

It has been possible to prepare, with the co-operation of a large electronic industry in the West, lectures and a syllabus plus data, covering the majority of the received requests. The syllabus also included some resumés of earlier lectures at the Shijiazhuang TV Factory.

THE SEMINAR PROGRAMME

Day

1 Principles of Colorimetry as applied in CTV.

2 NTSC, PAL and SECAM colour specifications. Coding Circuitry.

3 Introduction and Technical presentation of One Chip Small Signal BW TV Integrated Circuit Combination type TDA 4500/01.

4 Introduction and technical presentation of Integral Luminance and Colour Processing PAL Integrated Circuit, type TDA 3560/65.

5 Introduction and technical presentation of integral SECAM-PAL transcoding Integrated Circuit, type TDA 3590.

6 Technical Discussion of a recent CTV model with IR remote control facility.

7 The organization of the Circle TV Testpattern and its Application. Lecture on the differences, for CTV, between amplitude-versus synchronous video demodulation.

8 Received questions, as:

- SAW Filter Performance
- Computer Assisted Design
- Measuring Techniques - Standing Ware Ratio
- Digital TV
- High Definition TV
- Developing Trend Power Supply

9 Round Table, General Discussion

At the invitation of the Beijing Ministry a visit was paid to the Beijing TV Factory on 24-11-83. Besides being shown the assembly line, the vice-director exposed his views and his wishes with respect to possible co-operation with Western Industries.

Ease of manufacturing and high reliability are, as explained, of paramount importance to Chinese manufacturers. This opinion will be transferred to the concerned party.

VI Findings

a) Design Laboratory Personnel

Given the pace at which the electronic technique is renovating itself, it is of utmost importance to remain up to date for the laboratory engineers. Because significant advances usually appear in English or American publications, a certain knowledge of the English language is really a must.

A certain ability only to read technical journals is in itself not considered sufficient. Members of the design group should learn to speak and read (and write) English. This makes it possible for them to fulfil a training mission with a co-operative electronic industry abroad, preferably a supplier.

It might be a suggestion, to find interested young English or American teachers and to invite these for a half year's working stay at the TV factory. Of course, the factory designers must have had a preceeding minimal introduction respectively training in speaking (some) English, at the local University. In this way communication becomes possible for further personal teaching by the above mentioned English/American teachers.

b) Design considerations/recommendations

The harmonic design of a CTV receiver is directly limited to a sophisticated choice of its components.

Of these the picture tube and deflection circuitry form one part; the so called small circuitry another part. The composition of the small circuitry is, today available in IC form. It is believed that the various IC's to be chosen for the design should complement each other as effectively as possible, thus eliminating the need for too much interconnections or periphery. It is believed therefore that the selected IC's might, to some advantage, best be supplied as a set from one and the same manufacturer.

c) The Laboratory

- For safety reasons the working tables preferably should contain no metal parts.
- Attention should be paid to mains sockets with ground connections; fixed onto the tables.
- For test and measuring purposes, a signal distribution system with outlets at each table should carry RF testsignals. These can be obtained from the Signal Room, which also supplies RF signals to the assembly lines.
- Insulated contact clips of smaller dimensions than the bulky crocodile clips should be used instead in measuring set ups.
- Special clamps for fixing printed circuits in any working position should be provided for.
- Small-tip soldering irons should be used as well as suction type solder removers, this to exchange IC's.
- Subscriptions to leading technical publications in the electronic field (Electronics, IEEE Transactions; both USA) are strongly suggested.
- It is suggested to use trolleys for bulky measuring equipment as eg., an oscilloscope or a signal (sweep) generator.
- lighting should be improved.

d) General

- It is suggested to subscribe to component data publications of leading electronic manufacturers in the field, and to study carefully the specifications of modern components.

- It is suggested to arrange for one or more members of the design laboratory a practical training stay overseas. As explained before, this might be agreed upon with a supplying firm.

- Given the general advising task of the Ministry of electronic industry in matters of choice of suppliers, it is suggested that also the ministry might subscribe to component data books of leading manufacturers.

Acknowledgement

The author wishes to express his gratitude for the correct and most friendly way he has been welcomed, treated and accompanied throughout his stay in China. This applies equally to government officials as well as to all concerned members of the Shijiazhuang TV Factory. The technical contacts were very close, the laboratory staff taking part actively in practical work as well as in commenting during lectures.

The substantial electronic and design experience of the interpreter (a member of the TV Factory) greatly contributed to the communication and to the transfer of know-how.

The author has, at the request of the factory management, accepted to give advise to the Shijiazhuang TV Factory on an honorary basis, and, at the Factory's request, to pay eventually another visit to China.