K. Olsen B063

PERSONNEL LISTING

International Business Machines Corporation

244 Wood Street

Lexington 73, Massachusetts

July 15, 1957

ARNETH A P JR	702520	3 GRANT AVE WATERTOWN MASS	WA 4-7631	IBM 7296
BAHAN C W	803600	35 KENWOOD ST DORCHESTER MASS	AV 2-4778	F 401
BALDWIN J	504000	358 SOUTH ROAD BEDFORD MASS	CR 4-8159	IBM 7293
BEAN P W	805860	38 GENETTI CIR BEDFORD MASS	CR 4-8118	F 474
BEHNKE F A	606420	24 NEILLIAN STREET BEDFORD MASS	CR 4-8033	B 884
BELCHER R W	606490	1460 SHAWSHEEN ST TEWKSBURY MASS	UL 1-9586	F 474
BELEZOS M F	206523	70 CHESTNUT ST QUINCY	PR 3-8096	F 474
BELL J W	206630	24 QUINCY ST QUINCY MASS	MA 9-7232	F 474
BENKART D F	506880	11 MARION RD BEDFORD	CR 4-7968	IBM 7288
BOULEY R C	509730	24 MARGARET ST ARLINGTON MASS	MI 3-7970	F 474
BOWKER G A	509800	2 ELMWOOD RD LITTLETON	HU 6-3214	IBM 7258
BOWIE M J	309850	30 WHEATLAND ST SOMERVILLE	PR 6-6599	IBM 7260
BRETON L A	710881	30 NEILLIAN STREET BEDFORD MASS		F 410
BROGAN J A	711480	17 CAMBRIDGE TER CAMBRIDGE	KI 7-5018	RAND7331
BUCHANAN J D	012670	386 CONCORD RD RFD BEDFORD MASS	MO 3-4642	F 401
BURGESS R G	113080	23 SUSAN DR BILLERICA MASS	MO 3-4640	F 474
BURUD F A	413460	18 SENDERS CT HYDE PARK	HY 3-5431W	IBM 7276
BUTTERWORTH R	113740	3 PRESCOTT ST CHARLESTOWN	CH 2-2253	F 401
BYER K J	813800	2 BELVA RD BILLERICA MASS		F 474
CADY E C	713890	110 LEXINGTON RD BILLERICA MASS	MO 3-3032	IBM 7267
CANDELORO P J	814540	1192 MASS AVE ARLINGTON MASS		F 406
CANNIZZARO R	014760	11 CARLEY RD LEXINGTON	VO 2-1936	IBM 7294
CARTRON A E	015340	68 NORMAN ST NEW BEDFORD	WY 2-6930	F 474
CLARK D J	616890	BARNSTEAD RD PITTSFIELD N H	GE 5-6220	IBM 7287
COULOPOULOS W	419800	89 GERRY RD CHESTNUT HILL 67 MASS	HO 9-0853	IBM 7297
CRAIG R B	020210	637 WASHINGTON ST WELLESLEY MASS	WE 5-2274	IBM 7295
CRANDALL E P	319430	166 BRIDLE RD BILLERICA MASS	MO 3-2694	RAND7331
CROWELL P F	221010	60 SUMMER ST BEDFORD	CR 4-8117	F 401
DAUPHINEE R E	422471	55 BILLINGS ST NO QUINCY	PR 3-3576	IBM 7260

DELLINGER F M	323590	372 WEST MEADOW RD LOWELL	GL 2-1081	IBM 7261
DELAWARE L B	023660	98 IRVING ST WALTHAM MASS	TW 4-7181	F 474
DEPEW R D	542060	34 LOMBART RD ARLINGTON	MI 3-5821	RAND7331
DEROCHE P R	124140	35 WILLIAMS AVE HYDE PARK MASS	HY 3-1916R	F 401
DESART D A	924160	41 NEILLIAN ST BEDFORD	CR 4-0078	IBM 7282
DINSMORE G E	925042	63 NEILLIAN ST BEDFORD		F 410
DOROFI V W	825500	20 PARKER ST HYDE PARK	HY 3-3189J	F 7268
DOSSIN D A	425600	54 ELIZABETH RD BILLERICA	MO 3-8024	F 7266
DOUGHERTY R L	225683	3 SHERMAN BRIDGE RD WAYLAND MASS	EL 8-2680	B 243
DOWNS W M	525840	4 BEDFORD CT CONCORD MASS		F 474
DOYLE R H	025910	988 MEMORIAL DR CAMBRIDGE	TR 6-4280	RAND7331
GORDON C R	726250	38 GRANT AVE WATERTOWN MASS	WA 4-8395	B 882
DUKE P	922820	127 WASHINGTON ST BRIGHTON	ST 2-2976	RAND7331
DURKIN J F	226930	11 ELLIOT RD BEDFORD MASS		F 474
FINNEGAN D J	830540	182 LAUREL HILL AVE PROV R I	EL 1-6630	IBM 7287
FISH R C	330770	4 DICKINSON ST BILLERICA	MO 3-8252	IBM 7287
FLOTO E R	831210	93 RICE ST APT 1A CAMBRIDGE MASS	UN 4-4627	IBM 7286
FLYNN K J	231380	52 THESDA ST ARLINGTON MASS	MI 3-3718	IBM 7269
GEIGER A R	034580	21 EDMANDS ST SOMERVILLE	MO 6-1281	RAND7331
GERRAND F	834780	15 ELIOT ROAD BEDFORD MASS	CR 4-8020	IBM 7294
GARCIA M J	834820	22 VOSES CT STOUGHTON MASS	FI 4-4821	F 401
GOMBERG M	736030	60 FOWLER ST DORCHESTER	AV 2-2123	IBM 7288
GOOTNER R S	036160	42 NANCY LANE BROCKTON MASS	JU 6-8986	F 401
GRAY G I	536970	24 BRIDGE ST N BILLERICA MASS	MO 3-2593	IBM 7263
GUNNING R T	838140	71 HUDSON ST SOMERVILLE	MO 6-2698	F 406
HAMBURGER P E	439250	637 WASHINGTON ST WELLESLEY MASS	WE 5-2274	IBM 7288
HAUGEN R B	741210	BOX 208 NUTTING LAKE MASS	MO 3-3066	F 474
HAYES C E	841400	32 MAIN ST LOWELL	GL 8-8218	IBM 7284

HESTER W J	542863	303 GROVE STREET WESTWOOD MASS	DE 3-5245W	IBM 7259
HICKEY H G	743060	266 SOUTH ROAD BEDFORD MASS	CR 4-8032	C 184
HOSIE J A	445340	58 ELIZABETH RD BILLERICA	MO 3-3338	IBM 7277
HUGHES T A	046270	116 BOUCHARD AVE DRACUT	GL 4-1396	F 474
JACKSON R F	747510	67 CENTRAL ST W CONCORD	EM 9-9707	IBM 7264
HAYES V M	047860	39 FOX ST DORCHESTER MASS	GE 6-0382	RAND7331
KAIZER H	950000	182 RUTHVEN ST ROXBURY MASS	GA 7-2395	C 5380
KEALY W J	850630	22 EVANS ST BEDFORD		RAND7331
KELLEY D M	250850	13 LIBERTY AVE BURLINGTON	BU 7-4543	F 401
KELLY D E	750941	166 SHAW ST LOWELL	GL 3-5938	IBM 7256
KELTER A M	850961	202 WASHINGTON ST E WALPOLE MASS	MO 8-1618	IBM 7281
KIKLIS L C	051750	4 SHERMAN TER WOBURN	WO 2-4967W	IBM 7250
NATOLI J E	751870	152 OVERLOOK RD ARLINGTON	MI 8-4073	IBM 7261
KOTOWSKI J P	353310	41 CAREY AVE WATERTOWN MASS	WA 4-2264	RAND7331
LEE J D	755890	MORNINGSIDE LANE LINCOLN MASS	CL 9-8798	F 406
LEE D A	655930	40 ELIZABETH RD BILLERICA	MO 3-3625	IBM 7282
LEDBETTER J M	055960	23 EDGELAWN AVE N CHELMSFORD	GL 3-4638	IBM 7272
LEPAGE R J	156260	22 SUSAN DR BILLERICA	MO 3-3452	F 406
LE TORNEY R A	956330	66 CROSS ST FOXBORO MASS	KI 3-2187	IBM 7272
LETTENEY R C	856352	5 ARNOLD STREET QUINCY MASS	MA 9-7322	F 410
LEVY S	656380	130 NORTH AVE BEDFORD	CR 4-6724	IBM 7288
LEWIS A R	756420	73 BEAVER ST WALTHAM MASS	TW 4-4050	IBM 7286
LEWIS W J	756480	156 MAGAZINE ST CAMBRIDGE	UN 4-5476	IBM 7259
LITTLE J W	957460	69 ALDER ST WALTHAM MASS		IBM 7287
MARCOVITZ A B	960560	296 TAPPAN ST BROOKLINE MASS	BE 2-2081	IBM 7286
MARTIN D	761050	59 GLENBURN RD ARLINGTON	MI 3-5618	F 402
MATHYS C A	361460	38 CUSTER ST JAMAICA PLAIN MASS	JA 2-2623	F 401
MATHEWS R R	361530	20 WELLINGTON ST ARLINGTON MASS	MI 3-8799	F 474
MAYO R J	261872	117 SLADE ST BELMONT MASS	IV 4-6988	IBM 7256

MAYO R F	161990	90 SUMNER ST NEWTON CTR	BI 4-0587	F 401
MCCRACKEN M S	662580	107 BRIGHT ST WALTHAM MASS	TW 4-6291	IBM 7289
MC CUE E J	262620	14 HENRY AVE SOMERVILLE	PR 6-8500	IBM 7259
MCGINNIS G F JR	263112	26 BRADLEE RD MEDFORD 55 MASS	MY 8-0174	IBM 7272
MC ISAAC R F	963200	3 ECLIPSE AVE CHELMSFORD	GL 2-0941	IBM 7255
MCNAIR P P	463750	14 WADSWORTH ST WALTHAM MASS		F 401
MEAGHER M	864030	53 CURTIS AVE SOMERVILLE		F 401
MELANSON R L	264083	12 GENEVA ST SALEM MASS	PI 5-1938	RAND7331
MELANSON J J	664300	11 FILLMORE ST BEVERLY MASS	WA 2-8739	F 474
MIKONIS P JR	165150	LAKESIDE TR PK OAK ST N BILLERICA	MO 3-4010	F 401
MILLER H W	165460	9 NEILLIAN ST BEDFORD MASS	CR 4-8171	IBM 7286
MORRILL A B	867320	10 LINCOLN ST MAYNARD MASS	TW 7-8144	IBM 210
MUDARRI A H	867780	536 BOULEVARD REVERE MASS	RE 8-3169M	IBM 7273
MULLERY C E	168060	24 MARGARET ST ARLINGTON	MI 3-7970	F 401
MYERS P W	268490	4436 WASHINGTON ST ROSLINDALE MASS	FA 3-3807	IBM 7272
NALLY J E	868760	3 ELLSWORTH AVE CAMBRIDGE MASS	UN 4-9365	IBM 7258
NELSON G A	768900	284 CROSS ST WINCHESTER MASS		IBM 7287
O BRIEN H F JR	170290	5 WALNUT AVE NUTTINGS LAKE MASS		F 474
O BRIEN J T	170410	130 NORTH RD BEDFORD MASS	CR 4-6724	F 401
O CONNOR J A	670440	60 NEILLIAN ST BEDFORD MASS	CR 4-8292	F 401
OLDFORD N	070750	159 REED ST LEXINGTON	VO 2-3030	IBM 7276
OSENTON E R	471260	727 HEATH ST CHESTNUT HILL	LO 6-5980	D 818
PACKARD H M	571620	105 ELMWOOD AVE QUINCY	PR 3-8271	F 401
PALISOUL A	171800	32 MAIN ST LOWELL	GL 8-8218	IBM 7287
PASQUARIELLO J	672400	58 SUMMER ST BEDFORD	CR 4-7820	IBM 7281
PATTERSON W E	772580	35 PROSPECT HILL RD LEXINGTON	VO 2-1373	IBM 7292
PEARSALL G J	672711	106 SAYLES ST LOWELL	GL 4-6872	IBM 7270
PEAVY W R	072740	769 VFW PKWY W ROXBURY MASS	FA 3-1237	D 155
PETRUCCI R E	073770	17 WEBBER AVE BEDFORD MASS	CR 4-7625	F 401

PICARDI R H	973980	2 SCHOOL ST DORCHESTER	AV 2-7248	IBM 7267
POCKETT K J	274830	5 WYMAN RD BILLERICA		F 474
PULK E S	875410	38 WILLOW ST WELLESLEY HILLS	WE 5-7063	RAND7331
PUORRO T A	375640	12 JOAN AVE STONEHAM	ST 6-1486W	IBM 7285
REX F J JR	477110	40 ELIOT RD BEDFORD	CR 4-7011	IBM 7268
RENAUD N G	377180	14 WADSWORTH AVE WALTHAM MASS		IBM 7286
RIGBY A	177640	55 GARDEN ST CAMBRIDGE MASS	EL 4-4221	RAND7331
ROGERS L J	478610	8 NIMROD DR CONCORD MASS	EM 9-5025	IBM 7262
ROSE W L JR	278970	190 MAPLEWOOD AVE WATERTOWN MASS		F 401
RUFFINO L V	279630	45 THOREAU ST CONCORD MASS	EM 9-5315	D 186
SCHIFF A	081100	32A HARVARD AVE BROOKLINE MASS	AS 7-5520	IBM 7269
SEELAND J J	782110	63 HARVARD ST NEWTONVILLE		IBM 7282
SELFRIDGE J J	482210	17 ELIOT ROAD BEDFORD MASS	CR 4-8021	B 248
SANDEEN J C	882770	3 NEILLIAN ST BEDFORD MASS	CR 4-8285	IBM 7287
SHEA W J	582780	ROUTE 2 LINCOLN MASS	CL 9-8657	F 406
SHUR R W	683250	8 MONTCLAIR AVE WALTHAM	TW 3-5779	IBM 7291
SILVERMAN J I	883380	41 COLEMAN ST PEABODY	JE 1-5485	F 410
SIMPSON D G	283561	145 BROWN STREET WALTHAM MASS	TW 4-5026	F 410
PILLSBURY D	784342	29 GREENOUGH AVE JAMAICA PLAIN	JA 4-9869	IBM 7257
SMITH W E	984940	137 WEBSTER STARLINGTON	MI 3-1120	C 5380
SPILLMAN A	386010	2 WABON STREET ROXBURY MASS	HI2-6294	F 401
STANSBURY P M	286260	35 ST GERMAIN ST BOSTON MASS		F 402
STOCKWELL V J	486720	121 MAPLE ST BELMONT MASS		F 410
SWAN R W	188330	17 WEBER AVE BEDFORD MASS	CR 4-7625	F 410
SWANSON R A	988380	11 CARLEY ROAD LEXINGTON MASS	VO 2-1936	F 474
THEBERGE C	189920	59 GLENBURN RD ARLINGTON	MI 3-5618	F 402
THOMSON W M	990240	19 BONAIR AVE BEDFORD MASS	CR 4-8275	IBM 7288
TILLERY M L	890630	10 WADE AVE WOBURN MASS	WO 2-4904W	IBM 7286
TRIEST W E	691350	12 MANSFIELD RD WELLESLEY	WE 5-6487	D 818

TRENHOLM C D	291360	20 SUSAN DR BILLERICA	MO 3-4237	F	406
TRUESDALE G F	291650	17 USHER RD W MEDFORD MASS	MY 8-6471	F	474
VANWESTENDORP	592760	41 ERIE ST PROVIDENCE R I	TE 1-6339	F	401
VARTERESIAN R E	692962	35 SOUTH WAVERLY STREET BRIGHTON	AL 4-5951	F	406
WALDEN H M	193890	42 ALLEN ST LEXINGTON MASS		IBM	7287
WALLACE H C	494170	44 BEAVER DAM RD NATICK	OL 3-8938	RAND	7331
WATSON T H	795030	340 WILDER ST LOWELL MASS	GL 3-5418	F	401
WATSON W D	195060	14 CURVE ST BEDFORD MASS	CR 4-8148	F	401
WEBER F A	695270	115 SLADE ST BELMONT	IV 4-7879	IBM	7273
WEBBER N	495310	100 BRAINERD RD ALLSTON MASS	BE 2-7679	IBM	7281
WHITE H J	996390	45 HILLCREST ST ARLINGTON MASS	MI 3-8491	D	818
WHITE L A	696600	694 HUMPHREY ST SWAMPSCOTT MASS	LY 5-8891	F	474
WIERZBICKI J R	197000	45 COLLEGE AVE MEDFORD MASS	MY 8-2607	F	474
YASI E J	699232	15 CHAPPIE ST CHARLESTOWN		F	410
ZAJDEL J J	399440	20 WELLINGTON ST ARLINGTON MASS	MI 3-8799	F	474

met

JOB OPPORTUNITIES

Division 2
Division 3
Division 4
Division 6
Division 7

Personnel Office
8/10/56

DIVISION 2
Aircraft Control
and Warning

Opportunities for staff members in Division 2 occur within two broad areas of activity: (1) operational development, testing, and evaluation of prototype, semiautomatic air defense systems and their components, and (2) research on data processing and display techniques.

(1) In the first category, a portion of the effort involves various projects concerned with engineering modification and testing of conventional and advanced radar equipment which generate primary information on aircraft location and movement. Similarly, engineering and testing are conducted on equipment which transform the basic radar returns into digital data for transmission to a large-scale, central computer where the information is automatically processed for use in controlling interceptions and maintaining a current picture of the over-all air situation.

The advent of automation in air defense has created many unique problems in large-scale system organization, operation testing and evaluation. This is probably the first time that scientific planning and analysis have been called upon to measure, comprehensively and under realistic operating conditions (including participation of jet bombers and interceptors supplied by the Armed Forces), the integrated capabilities of recently developed components to perform the various functions necessary for countering modern aerial attacks. Not only must tests be designed to yield maximum information regarding over-all system performance, but they must also provide data on the effectiveness of integral parts of the system such as tracking, program logic, intercept direction, human monitoring, etc.

(2) In the research area, Division 2 is investigating many facets of high-speed data processing including, on the one hand, transmission of information between widely dispersed machines and, on the other, the conversion of this information into displays which are significant and useful to human operators. An example of work in the first of these fields is the problem of converting signals from distant radar sites into information which can be sent over telephone lines or via radio for use as input data to a central computer. Statistical analyses of signal detection underlie much of this work, as does prototype development of equipment necessary to sustain theoretical conclusions. In this connection, the Division's research on transistors and transistor circuits is opening new aspects in the application of solid state physics which were not envisioned several years ago. One of these is appearing in the development of a small, high-speed computer built primarily around solid state devices rather than vacuum tubes.

Investigation of displays and display techniques has also proved an interesting and productive part of the Division's research effort. Here the problem is one of studying ways and means of presenting timely information to human operators without compromising their reactions by difficulties of low light levels, flicker disturbances, or poor persistence. Various approaches to these problems are under consideration by the research staff, including the improvement of charactron and typotron tubes, high-speed photographic and projection possibilities, and the application of such solid state phenomena as electroluminescence, photoconductivity and light amplification.

Also in the area of research on data processing and transmission are the beginnings of stimulating and eventful work on pattern recognition by electronic machines and their reproduction of "learned" patterns in recognizable form. Where such research will lead is difficult to predict at the moment. It is mentioned along with the preceding notes to place in perspective for imaginative physicists, mathematicians, engineers, chemists, operations analysts and other interested personnel the breadth as well as the depth of Lincoln Laboratory's endeavors to undertake and solve pressing defense problems, while at the same time advancing human understanding in yet unexplored fields.

Specific Assignments:

1. The new staff member will be taught computer programming and indoctrinated in air defense systems as part of his training. He will then work on the analysis and evaluation of a prototype air defense system. The work involves analytical investigations, experimentation, data reduction, and data analysis. Routine data processing is done with digital computers leaving the engineering analysis to the staff. Working from the analysis of experimental data, the staff go on to develop improvements in system performance.

   (B.S. or higher, Physics, E.E., or Math.)

2. This position is in the Mission Operations Section and entails performing operational liaison, conducting or assisting in the conducting of flight tests.

   (B.S. plus flying or airways operation experience)

3. Experimental Physicist or Senior Electrical Engineer to work in field of solid state physics. The work includes design and development of display processes; for example, electroluminescence,

photoconductivity, optical feedback storage cells, light amplifiers, matrix arrays, pulse switching, etc.

(Ph. D. Physics, or 4 years experience solid state)

4. Electrical engineer or experimental physicist to work in the field of solid state physics. Instrumentation for measurements in the fields of electroluminescence and photoconductivity. Investigation of pulse switching circuits for matrix arrays and assisting in the development of optical feedback storage cells.

   (B. S. or M. S., Physics or E. E.)

5. Supervisor for a radar field station with complement of technicians, Air Force, and engineering personnel. Requires three to five years in radar and/or computer systems engineering.

   (B. S., E. E. or Physics)

6. Assistant to senior engineer on the development of the control section of an all-transistor high-speed digital computer. Will work on the development of logical networks. Will design, oversee construction, and conduct tests of experimental control assemblies.

   (B. S. or M. S. in E. E. or Physics. One to three years experience in logical or switching circuit design. Experience in electronic circuitry amplifier, trigger circuits, etc. is essential.)

DIVISION 3
Communications
and Components

Division 3 conducts a program of research in communications and radar techniques, along with component development. Much of its work seeks early solution of air defense problems. Other work, particularly in solid state physics, is of a more basic nature, implying less emphasis on immediate, specific uses.

In the field of radar, effort is directed toward the development of high-powered, long range systems. Here, emphasis is given to both analytical system studies and the development of unique, advanced equipment.

Division 3 devotes high interest to theoretical and experimental aspects of the communication field. It is concerned with studies of ionospheric and tropospheric radio-wave propagation, the development of specialized facilities for long range radio communication, and refinement of techniques to promote reliable communication in the presence of natural disturbances, jamming, and intercept.

As an integral part of its program, a relatively large solid state physics research group is engaged, not only in fundamental studies of semi-conductors and magnetic materials, but also in the application of basic principles toward the development of new solid state devices.

In addition, a group of applied psychologists is concerned with human operator problems in relation to air defense systems and equipment.

There are opportunities in Division 3 for persons having interests in and fundamental knowledge of broad areas of physical science as well as those interested in the development of components and the organization of systems.

Specific Assignments:

1. Electrical engineers or physicists with high mathematics interest to do logical analyses toward detection systems planning. This work will combine interests in radar and digital computer systems.

   (B.S. or higher in E.E. or Physics)

2. Radar component and system development work in connection with high-power experimental radar systems. There are a large number of tasks, some involving detailed equipment design skills and others of a less complex nature.

Experience in one or more of the following fields of activity is desirable: Radar system development, high-power transmitters, UHF receiver design experience, RF plumbing techniques, digital and analogue display devices, transistor circuitry or filter design.

(B.S. or higher in Physics or E.E., plus 2 or more years experience.)

3. Research on imperfections in semiconductor single crystals. This program involves many aspects of physical metallurgy or "metal physics." A knowledge of dislocation theory, coupled with some experience in deformation studies, is desirable.

(Sc.D. or S.M.) (Experience in fields of deformation and X-ray diffraction.)

4. Development of tropospheric scatter communication equipment, with particular emphasis on the development of speech compression equipment employing transistors.

(B.S. or M.S. plus 2 years)

5. Work in a group on the development of radar components at radio frequencies from VHF to microwaves. Electronics, gaseous electronics, and solid state physics are the fields involved.

(B. S. or M.S., Physics or E.E.)

6. Project Engineer to oversee the design, development, installation, and testing of UHF Radio Communications Systems.

(M.S. in E.E. plus 5 years. B.S. plus 5 years)

7. Research on human-operator capacities relevant to the integration of the operator into large semiautomatic control systems.

(Ph.D. or equipment experience in psychology.)

8. Making microwave measurements for the verification of theories of operation of various microwave devices such as ferrite devices.

   (Sc. B. or M.S., Physics or E.E.)

9. Initiate and direct studies concerning learning pattern recognition; developing models. This entails research basic in character and broad in scope.

   (Ph.D., physical science, some knowledge of physiology and psychology)

DIVISION 4
Radars
and Weapons

Division 4 of the Lincoln Laboratory is engaged in the design, development, and testing of radar systems for ground and airborne use, in the development of components for these systems, and in the basic research necessary to support such a program. The various groups of the Division, although somewhat specialized in their programs, support each other in the fulfillment of the Division's tasks; there is no one group engaged in basic research per se, for this activity is carried out to some extent by each group as part of its development work.

Without exception, the groups of Division 4 are equipment groups, working with, developing, and testing various equipments intended in part or in whole for service use, as well as associated gear necessary to electronic experimentation. Currently, the Division is concentrating its efforts on such equipments as airborne early warning systems, heavy ground radars, low-altitude intercept and tracking radars, and high-power radar transmitters and receivers. Considerable attention is being directed to the jamming-anti-jamming problem. One group of the Division has been assigned the responsibility of developing microwave components for equipment developed throughout the Laboratory.

Specific Assignments:

1. A physicist or engineer is required to participate in the design and implementation of ground radar systems, particularly in that of the exciter (for the transmitter), the receiver, and data-processing equipment. Prototypes of these components will be designed and constructed by the group. The work of this man will be evenly divided between theory and circuit design.

   (M.S. or Ph.D., Physics, E.E.)

2. An engineer is required to assist in the design, development and testing of electronic circuits and equipment for tracking radar systems, including pulse generators and amplifiers, timing and gating circuits, feedback control loops and other special-purpose devices.

   (B.S. in E.E.)

3. A physicist or engineer is required to plan, execute, and test airborne radar systems. During the design phase of an equipment, this man will

advise on such problems as environmental suitability, aircraft-imposed space restrictions, and the selection and construction of components, and will suggest new techniques or improvements in existing radar practices. He will have full responsibility for accomplishing the equipment installation and will direct technician personnel in this work. In addition, he will be required to fly once or twice each week aboard military aircraft (either multiengine conventional or lighter-than-air) to flight test the equipment.

(B.S. in Physics or E.E.)

4. A physicist or engineer is required to assist in the development of airborne radar systems. His work will fall almost entirely within the field of development although he will work with equipment and may be called upon to fly with this equipment from time to time. His primary responsibility will be the generation of ideas in the realm of new electronic techniques and the improvement of existing techniques; he will be free to develop and test his ideas and to present them at any time.

   (M.S. or Ph.D. in Physics or E.E.)

5. A physicist is required to assist in the development and application of TR tubes. This man will be an assistant to a Doctor of Philosophy engaged in research and development in Microwave gas discharges. (The learning opportunity here appears magnificent.) He will also be called upon to set up experiments, operate equipment, take data, and engage in research, under supervision.

   (B.S. in Physics)

6. An engineer is required to supervise the construction and effect the maintenance of special purpose digital computers, primarily using standard electronic building blocks, as applied to radar receivers, and to operate such equipment in gathering experimental evaluation data. He will also design ancillary equipment such as pulse generators and tuning signal generators.

   (B.S. in E.E.)

7. A physicist or engineer with two years experience in radar or related fields is required to develop, construct, and test high-power, advanced design radar systems for use in the Continental Radar network. This work will be particularly concerned with klystrons and traveling wave tubes. Considerable opportunity is available to influence the design of new klystrons, traveling wave tubes, and thyratrons. Most of the work will be concerned with peak and average powers at least an order of magnitude greater than the powers found in radars now in general use. The instrumentation needed on transmitters of this size poses rather special problems which are not yet solved and form a part of this assignment.

(B.S. or M.S. in Physics or E.E.)

8. A physicist or engineer is required as a junior antenna engineer to make bench and field measurements of antennas and their components, under supervision. He will also plan the general development of some parts of microwave antennas and do analytic work. He will participate in an antenna development program designed to extend frequency coverage to new ranges, to explore new techniques, to control beam shapes and extraneous radiation, and to investigate the adaptability of new antenna techniques to specific problems.

(B.S. in Physics or E.E.)

DIVISION 6
Digital Computer

Division 6 has two areas of responsibility. One is research and development on digital computing systems and components in order to improve the reliability of existing computer equipment and methods while searching for and developing new techniques and equipment. This work is subdivided into several areas of study:

1. Magnetic materials research; (thin films and ferromagnetic spinels).
2. Magnetic core memory systems.
3. Electronic circuits and devices.
4. Transistor circuits.
5. Cathode ray display devices; (charactron and typotron).
6. AC and DC power supplies and controls.
7. Experimental Computer Laboratory; (TX-0, TX-2 computers).

The second area of responsibility is the application of digital computers to real-time, (active) systems, especially SAGE, a continental air defense system utilizing networks of radars to feed information to centralized computing machines which in turn control air defense weapons. This work is divided into the following areas of concentration:

1. The operation and perfection of three large scale, high speed digital computers: Whirlwind I, the Memory Test Computer and XD-1.
2. Assisting Division 2 with the operation, maintenance and evaluation of "Cape Cod", a small experimental air defense system controlled and operated by the Lincoln Laboratory.
3. Assisting Division 2 and outside agencies with the design, installation, shakedown, operation, testing, evaluation and maintenance of the Experimental SAGE Subsector (ESS), a limited prototype of SAGE, with primary emphasis on the equipment at the computer site.
4. Design and production of the master computer program for ESS and SAGE.
5. Directing preparations for the shakedown, testing and evaluation of initial SAGE subsectors.
6. Evaluation and modification of SAGE design.

Specific Assignments:

1. Systems planning, design, and analysis in the field of real-time control by the use of digital computers. Preparation of operational and mathematical specifications which translate military operational requirements for a real-time control system into a set of specifications from which equipment, communications, and input and output data requirements can be ascertained, and a digital computer program can be designed and written. Operational specifications describe the complete operation of the system and its various control stations from the operator's viewpoint. They include a definition and description of each system function, its external and internal environment, responsibilities, operating techniques, input and output data requirements and processing, and equipment and computer facilities. Mathematical specifications define the transfer functions of computer programs and include the mathematical equations, criteria, and parameters and timing necessary to the design of the logic of computer programs which process input and output data.

   (B.S., Physics, Math., or E.E.)

2. Design and development of equipment for converting commercial power service into power consumed by large-scale digital computers, including highly-regulated a-c and d-c power supplies and sequential and protective relay circuits. Principals of servomechanisms, transients, electronic circuits, and switching circuits using vacuum tubes, transistors, and magnetic amplifiers. Will also work into magnetic switching circuits for computers.

   (B.S. in E.E.)

3. Immediate assignment will involve this man in the design and development of small electronic systems to be attached to the SAGE (XD-1) computer.

   (M.S. or candidate in Physics or E.E.)

4. System engineer to work on modification, maintenance, and improvement of large-scale digital computer systems. Work involves understanding the logical arrangement of the computer, the details of the equipment design, the methods for trouble detections and diagnosis, and the make-up and use of computer programs for equipment testing. The work

emphasizes the single-system concept. Problems must be studied and work must be reviewed in relation to their effects on the system as a whole.

(B.S. in E.E. plus engineering design and development experience.)

5. Theoretical and experimental studies of digital computer circuits and components. Development and design of basic units for experimental data-processing systems.

   (M.S. in Physics or E.E.)

6. Do experimental work in connection with the investigation of magnetic materials as computer components, especially in the area of evaporated thin films.

   (Ph.D. in Physics plus experience.)

7. Experimental investigation of magnetic materials; design of experimental tests for magnetic materials to be used in specific applications; design of new memory schemes using magnetic materials.

   (B.S. or M.S. in E.E. or Physics.)

DIVISION 7
Engineering Design
and Technical Services

The Engineering Design and Technical Services Division of the Laboratory is concerned with problems in mechanical and structural design, heat transfer, stress analysis, power generation, and construction engineering. In each of these areas there are many interesting problems peculiar to a research laboratory providing opportunity for varied assignments.

Mechanical engineers undertake engineering analyses of mechanical systems, such as antennas 200' or more in diameter and radomes to enclose them, determine their feasibility, make stress analyses, and prepare design studies for submission as formal reports.

A mechanical design group works with the research divisions to design or modify mechanical devices for a specific application. The engineers prepare design studies, supervise the preparation of working drawings, have the apparatus built, and submit a completed working unit to the originator. By working as teams, these engineers have successfully designed and built drive systems (involving servo-mechanisms), azimuth marker devices, tuning devices, support structures, and the recently completed bearing modification for a 120' antenna.

All site buildings, as well as most towers and foundations, are designed by Division 7. Civil engineers and building construction specialists make topographical surveys, design buildings, supervise installations, provide for electrical power, and engineer heating and ventilating systems.

<u>Specific Assignments:</u>

1. Mechanical engineer (Heat Transfer). Work in theoretical and applied heat transfer, especially in relation to electronic gear. A small squad is conducting a basic research program in heat transfer, with the purpose of building up a body of design data. Applied engineering on specific problems within the Laboratory serves to corroborate research findings as well as to render valuable services.

   (B.S. or M.S. in M.E.)

2. Mechanical engineer. Work in the mechanical engineering section on electromechanical devices. Make modifications to existing radar components, and develop new devices to perform specific requested

functions. Recent work involves design considerations for large antennas and their drives. Stress analysis is an important part of the job. Experienced draftsmen are available to assist.

(B.S. in M.E. plus 5 years experience)

3. Electronic (Packaging) engineer. Engineer the packaging of Laboratory-developed electronic equipment. Would work in the engineering development section where experienced draftsmen are available to assist. Requires close contact with originating engineers, the Machine Shop, and the Wiring Shop.

(B.S. in M.E. or E.E. plus 5 – 10 years experience)

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K. Olsen

Issue XI

GROUP 63 BIWEEKLY

(Period: 23 March to 5 April 1957)

SUMMARY

This period's report contains items under the following titles:

William N. Papian

Distribution:
- Group 63 Staff
- S. T. Coffin, Group 62
- R. Fallows, Group 62
- Frank Hazel, Group 60
- William Triest, IBM
- Frank Heart, Group 22

1. Physics of Magnetic Materials

Measurements - - Measurements of the magnetic anisotropy of manganese ferrite have been taken as a function of temperature from - 196°C to room temperature. Further calibration and computation is needed for final determination of the anisotropy constants, but the internal consistency of the data indicates that the first order anisotropy constant can be determined with an error of the order of 1 per cent, and the second order constant to within 10 per cent.

(N. Menyuk and K. Dwight)

High Vacuum - - Experiments to determine the possibility of outgassing the metallic charges used in evaporation have been continued. A better method for reading the temperature of the charge has been found: the thermocouple is now cemented to the bottom of the inner cricible. The best experiment showed that after the temperature of the charge was slowly increased over a 30-minute interval to above the melting temperature, the pressure above the molten charge was about $1 \cdot 10^{-5}$ mm Hg. After three hours of outgassing at different temperatures, the pressure above the molten charge was $4.8 \cdot 10^{-6}$ mm Hg. Since this value is very close to the ultimate pressure that can be obtained within the bell-jar system, these experiments were stopped. There will probably be no detectable difference in the vacuum properties of different crucibles, unless we have our new vacuum system where much lower pressures can be obtained. However, these first results are very encouraging. It seems possible to maintain in the bell-jar systems during the evaporation pressures of about $5 \cdot 10^{-6}$ mm Hg. (one order of magnitude better than till now), if the charge is outgassed carefully. Moreover, even lower pressures may be attainable in systems with a lower ultimate vacuum.

(Klaus Behrndt)

Thin Film Switching Experiment - - A new transmission line has been designed for the switching experiment. The new line has two pickup loops made from printed wiring in order to minimize the gap between the films and the loop. A new set of coils has also been designed to produce a transverse d.c. field for this line. (G. P. Weiss)

Production of Thin Films - - The deposition field coils of the vacuum evaporator have finally been repaired and this week four runs were made.

A protection system is being designed to eliminate the danger of damage to the diffusion pump in case of power-failure or loss of vacuum. This will permit overnight operation of the diffusion pump and therefore lower evaporation pressures. (F. S. Maddocks)

2. Ceramics

Thin ferrite plates - - Regular memory core material was pressed into very thin plates (approximately 0.03 in. thick) fired and refired for Al Guditz.

Core Aligner - - Allen Spurr and Richard Germann have designed a core aligner which greatly reduces the time required for loading the large furnace.

Experimental Ferrites - - B-H loop measurements, microstructure studies, study of the effect of magnetic annealing, and a study of firing cycles are in progress for bodies of the ferrite $Fe^{3+}\left[Ni_{1-x}^{2+}Co_x^{2x}Fe^{3+}\right]O_4$

Toroids composed of 40 mol per cent MgO, 40 mol per cent Mn_2O_3 and 20 mol per cent Fe_2O_3 have been prepared to aid Group 37 in their evaluation of a microwave body of the same composition.

Density studies for yttrium ferrite and regular memory core ferrites are almost complete.

(C. O. Dugger)

3. Core and Film Testing

The new track and contacts reported in the last biweekly seem to work quite well but we still cannot get 100 per cent of the cores in the accept bucket to be good cores.

To test the above, 4,468 cores were retested by hand on the old tester. We found 64 rejects which upon examination under a lens proved to be c chipped cores (1.43 per cent). The good cores were given to Hilda for the wiring of the first 64 x 64 plane using the 50-30 cores.

(R. C. Zopatti)

4. Inorganic Chemistry and Crystallography

$Mn^{++}M_{1-x}\left[Mn_{2-x}^{++}M'_x\right]O_4$ - - Experiments have been continued to synthesize a spinel where Mn^{++} ions occupy both tetrahedral and octahedral sites in the spinel lattice, and where M' is Su^{+4}, Ti^{+4}, and Mo^{+4}.

(D. Wickham)

Rare Earth Ferrites - - Lanthanum iron oxide and lanthanum chromium oxide form a complete range of solid solutions. The unit cell dimensions of the perovskite structure change in the manner expected with change in composition. The extent of cation ordering will be studied with the aid of x-ray diffraction and magnetic measurements.

(A. Wold)

5. The 2½ Megabit Memory

It has been proved experimentally that the noise of a "bad" plane can be reduced to a level equivalent to that of an average plane. The method involves the connection of a capacitor externally from one side of the noisy sense-winding to the memory-frame ground.

5. The $2\frac{1}{2}$ Megabit Memory (cont.)

A plane has been removed from the stack for visual and electrical inspection for the purpose of determining the cause of the apparent unbalance of capacitance. Attempts to establish these differences with capacitance measurements have not been too successful. The next series of tests will attempt to simulate operating conditions with the ability to vary interconnections and modular winding as needed.

(D. H. Ellis)

6. Transistor-Driven Memory

Some new circuits have been investigated for turning on and off the Read (or Write) current generator, but they are too slow and/or burst sensitive.

I attended the last two sessions of the symposium on the Theory of Switching. Minnick presented a paper on a memory system in which two words could be simultaneously read out of a memory. Multiple windings on cores are necessary that give the memory the appearance of his redundant selection systems.

One paper by Bell Laboratories started out with direct coupled logic but ended up with TX-2 circuitry using bias for greater margins.

National Cash Register has some interesting chemical memories that have milli-second response time. They respond to different wave lengths of light.

(G. A. Davidson

7. Drive Circuits

A large quantity of data has been taken using various small tape cores in various manners, in an attempt to find a "correct" design for driving a thin film memory. None of the schemes has worked perfectly, but the results are reasonably good. For instance, in driving the approximate equivalent load as seen by the switch (0.22 μh), it is possible to obtain the following results: 314ma, with a switching time of 0.20 μsec; or 586ma, switching in 0.30 μsec; or 947ma, switching in 0.5 μsec. Of course, these results are obtained with a net driving force of somewhat less than 5 ampere-turns. With a more powerful excitation the figures would be more impressive. The rise time of the driver is about 0.10 - 0.15 μsec, and so it is difficult to switch the cores much more rapidly than about 0.20 μsec.

(S. Bradspies)

8. Fabrication Techniques

TDCM - - Cores have become available for the first TDCM plane which is being wired without the help of a core-positioning jig.

Excellent butt-welds are being made between .008" O.D. steel needles and .005" copper wire. An optical alignment system has been devised which will aid in centering the wire to the needle. The equipment is being rebuilt to facilitate rapid production welding.

8. Fabrication Techniques (cont.)

16^2, 50/30 Core Planes - - Twelve of the 18 planes requested have been completed, but are not tested.

3-D Printing - - Masks for printing multiple turns on a toroid have been completed. A suitable mounting for exposure is being prepared.

Samples of plated connections have been submitted to the component evaluation group for study.

(E. A. Guditz)

9. TX-0 and TX-2

Low Impedance Transmission Line - - We are considering distributing TX-2 3 volt clock pulses on a low impedance, unbalanced, parallel-plate transmission line. A prototype line with two ohm characteristic impedance has been built. The results look promising. As yet, however, the reliability of the device is not sufficient. The thin dielectric (.002" teflon) is shorted rather easily.

TX-2 Clock - - A seven tube clock circuit has been built. It produces two outputs at 2.5 mc with 180° phase difference. At present the peak output is 36 watts. The goal is two or three times this power.

(B. M. Gurley)

In-Out Coax Cables - - A coaxial cable system for TX-2 has been developed for bringing the large numbers of cables required by certain registers from memories and in-out equipment. Miniature 93 ohm coax cable similar to modified RG-62U is being used. A cable consisting of ten or these coaxes with an extruded jacket will be brought to an 18 pin connector similar to that used on the standard TX-2 transistor package. This will be plugged into a mating connector mounted in the TX-2 frame. A special hood for the connector has been designed to properly secure the ends of the coax cables.

Clock Pulse System - - As an alternate approach to the clock pulse generation and distribution system described by Ben Gurley, I have been working on a system using a larger number (30) of 2420 vacuum tubes to drive pulse transformers, two of which will be located at each register. This would eliminate the necessity of transmitting pulses on a low impedance transmission line since all associated register drivers would be near enough to allow the use of open wiring or simple shielded wiring.

18 Pin Connectors - - Some difficulty has been encountered in soldering to the 18 pin Winchester receptacles used on the TX-2 frame. This problem has been solved and future trouble obliviated by hot solder dipping the turret terminal portion of the receptacle pin. Connectors now on order have been specified with extra heavy gold flash and hot solder dip.

(Ken Konkle)

9. TX-0 and TX-2 (cont.)

Power Supply Control - - The new TX-0, TX-2 power supply control was installed without incident.

(R. A. Hughes)

TX-0 Operation - - The computer has been shut down the past week for installation of the new TX-0 and TX-2 Power Control. It is expected that the computer will be fully operational by April 15.

The compressors for the air conditioning system have been repaired by the Westinghouse dealer and will be returned and installed next week. An investigation will be made into the cause of their failure to prevent reoccurrence in the future.

One plane of core memory has been removed from the Memory Stack by Don Ellis to investigate noise conditions caused by non-uniform winding of the sense windings.

The improved Display System and Epsco Analog-to-Digital Converter System are in the process of being integrated into the TX-0 system.

The investigation of the margins of TX-0 has been continued. All flip-flops in TX-0 now have minimum margins of ± 12 volts. Further studies will be made of the marginal checking system.

A spare PETR box is being wired and checked out for use as a standby.

TX-2 Assembly - - The full 36 bit B and C registers, 18 bits of the A and D register have been constructed and are ready for testing. The E, F, K, M, N, P, Q, XA and the balance of the A and D registers are in construction or inspection.

A program to test the completed registers will be worked out and put into operation within the week.

(C. Norman)

10. TX-0 Programming

The program for displaying samples from the Epsco Analog-to-Digital converter was debugged last week and is running satisfactorily. This first version utilizes toggle switch storage for external control. Once TX-0 is running again the program will be operated to determine several sets of desirable parameters. When these are found the external control will be modified to enable the observer to quickly select whole sets of parameters, (probably by means of the flexowriter since we do not have a light gun).

Using the program an observer will be able to examine samples stored in memory by moving a window along the time axis of the stored data, expanding or contracting the time axis or the amplitude of the data or both.

10. TX-0 Programming (cont.)

The next version of the program will be able to display other curves associated with the data, i.e., envelope plot of maximum and minimum points, etc. Also an indicator will be displayed to indicate the position of the window on the time axis.

(J. Gilmore)

11. Display

XD-1 - Several weeks ago it was discovered that the curls in the XD-1 SD vectors could be eliminated by clamping out the noise on the digital input lines at each digital-to-analog decoder. This appeared to be a rather expensive method, so considerable study has been made to find an alternative method.

It has been discovered that the sensitivity of the decoder to this noise could be reduced by capacitively loading the inputs to each decoder to increase the input rise-time. However, the rise-time must be increased so much that the display is seriously affected before all traces of the curl disappear.

A second attempt concerned the feature gates which appear to be the major contributor of noise on the digital display lines. Slowing up the rise-time of these gates also reduced the noise but again the rise-time had to be decreased to such an extent that the displays suffered.

A third attempt consisted of grouping consoles and trying to clamp each group separately instead of clamping at each console. The smallest possible grouping in this system consists of all consoles on any given branch line. However in any grouping, the console nearest the clamped distribution box would be free of noise, but the fifth console away from the distribution box was essentially unaffected by the clamp. Since the groups could not be made small enough this system was discarded.

It now appears that the only remaining alternative would consist of recabling the distribution system to eliminate the coupling between the digital display lines and the feature gates. Since this procedure would be considerably more costly than clamping each console, and since there is no guarantee that the coupling could be sufficiently reduced to eliminate the curling vectors, a recommendation will be made to IBM to proceed with the clamps for each console. The clamping will consist of four adaptors for each console plus some modification of the cathode followers driving the digital display lines to handle the additional load of the clamps.

Magnetic Deflection System for Remote Display - - Three new magnetic deflection yokes for the remote display tube have been received. Preliminary tests on these yokes indicate that a slight modification will be necessary in the magnetic deflection decoder bits to increase their current handling ability. However, these modifications merely consist of a change of resistor values and will not affect the present schedule.

(H. E. Zieman)

11. Display (cont.)

Bldg. F Digital Clock - - The values of the different series resistors for the various bulb positions in the 5 x 7 neon arrays of the digital clock for Building F have been determined and sent to Stromberg Time Corporation, who will build the clocks. Variations in the neon bulbs and the selection matrix diodes will probably give wide variations in bulb intensity but fortunately it is far from critical.

Mixed Phosphor Charactron - - The charactron with the mixed P25 - P16 phosphor has been installed in the MTC - connected console in B-034. A clear implosion shield has been used and it appears at first look that the blue flash will not be objectionable. Console troubles and shortage of MTC time have slowed up the aligning of the console.

XD-1 Light Gun - - A test of the XD-1 light gun borrowed for use with console showed that the funnel-shaped light shield recently installed over the lens reduces the signal from the gun by 15 to 25 per cent and reduces the acceptance angle by under 10 per cent. Its value is questionable. The point of maximum sensitivity of the light gun was found to be at the edge of the aiming spot instead of at the center.

(R. H. Gould)

12. Personnel

Mr. Donald I. Underwood is a new staff member in the Display Section, Room B-132.

(M. Keene)

Ken Olsen

Issue XX

GROUP 63 BIWEEKLY

(Period: 27 July to 9 August 1957)

SUMMARY

This period's report contains items under the following titles:

awp

Distribution:

Group 63 Staff
Division 6 Group Leaders and
Assoc. Group Leaders

1. Physics of Magnetic Materials

Measurements - - The calibration of the carbon resistance thermometer has been completed over the temperature range from liquid helium to room temperature. A curve of resistance versus temperature has been established.

Anisotropy measurements on a single crystal ferrite sample were attempted, but the noise levels were too high for an accurate determination of the anisotropy constants. The noise source was traced to the mechanical vibration of the coil. This noise has been greatly reduced by replacing some of the vibrating rods, and present operation appears to be satisfactory. However, an improved design has been formulated, and the improved system will be installed when the expected deterioration of the signal-to-noise level occurs again.

The magnetic moment of approximately thirty samples was determined at 4.2°K. These samples were prepared by A. Wold and D. Wickham, and the results of the measurements have been turned over to them for analysis.

A paramagnetic susceptibility versus temperature measurement of lanthanum-nickel oxide has been begun.

(N. Menyuk and K. Dwight)

Thin Films - - A new balanced pickup loop with a rotating sample holder has been assembled using a G.R. balun. This unit will be used to measure ferromagnetic resonance in the frequency range 500-5000 mc.

The design of a set of balanced pickup loops for pulse experiments has been completed and is in the machine shop. It is expected that by feeding the output of these loops directly to the deflection plate of the travelling wave oscilloscope, further reduction in noise can be obtained.

(G. P. Weiss)

In addition to the routine production of thin films for test purposes, several changes to the vacuum system have been made.

An improved substrate mounting assembly has been installed. This assembly permits rapid change of experimental substrate holder, such as the heated vacuum strip line, a motor driven rotating substrate, and others.

It seems probable that at least some films are produced which have a slight oxide coating. An experiment is being set up to try to reduce this layer, if present, in a heated hydrogen atmosphere.

(F. S. Maddocks)

Domain growth and other forms of wall motion are being studied by the Bitter Technique, using a single, small current carrying wire in direct contact with the surface of the film. The effects of external fields upon the perpendicular wall "cross Ties" are particularly interesting. These cross ties can be made to nucleate, bend, or disappear, depending on the magnitude and sign of an external field applied perpendicularly to the main wall. Other types of experiments are being continued in order to try to find the local variation of direction of magnetization within a domain.

(E. E. Huber, Jr.)

Core Switching Measurements - - Using the E.G. and G. Scope, switch-time determinations have been made for standard-size cores driven by unusually high fields, up to 60 oe. Switch-times down to around 15 musec have been observed, and the linear relationship between $1/\tau$ and H has been found to hold quite well all the way up to 60 oe. drive.

S_W determinations have been made for a series of cores having varying mean grain size resulting from varying annealing temperature. No correlation between S_W and grain size has been perceived.

(S. Richert)

2. Ceramics

Microwave Ferrites - - The following compositions have been prepared in the search for a satisfactory microwave body.

$$(MgO)_{0.40}(Mn_2O_3)_{0.60-x}(Fe_2O_3)_x \quad 0 \leq x \leq 0.16$$

$$(LiFe_5O_8)_{1-x}(LiFeO_2)_x \quad 0 \leq x \leq 1.0$$

Thermistors - - The compound $NiMn_2O_4$, parent substance of thermistor bodies under investigation, has been found to exhibit a saturation magnetic moment of approximately 0.6 u_B/molecule at 4.2°K.

Filter Ferrites - - The following nominal compositions have been prepared: $\left[Fe^{3+}(Fe^{2+}Cr^{3+})O_4\right]_{1-x} \left[Fe^{3+}(Co^{2+}Cr^{3+})O_4\right]_x$. A high sintering temperature has been used but the oxidation state of the iron is still uncertain. Cores have been given to Bob Lerner for testing.

(C. O. Dugger)

3. Inorganic Chemistry and Crystallography

The System $Ge^{+4}Co_2^{++}O_4 - Zn^{++}Mn_2^{+++}O_4$. - - Solid solutions have been prepared extending from pure $ZnMn_2O_4$ to 30 percent $ZnMn_2O_4$, 70 percent $GeCo_2O_4$. A significant saturation moment is observed for cubic materials containing less than 65 percent $ZnMn_2O_4$. Samples containing more than 65 percent $ZnMn_2O_4$ are nonmagnetic and crystallize with tetragonal symmetry. The maximum moment is observed for 62 percent $GeCo_2O_4$ - 38 percent $ZnMn_2O_4$ or presumably $Zn^{++}_{0.38}Ge^{+4}_{0.62}\left[Co^{++}_{1.24}Mn^{+++}_{0.76}\right]O_4$. The moment appears to result from magnetic interactions between the Co^{++} and Mn^{+++} ions, both occupying the octahedral sites on the spinel lattice.

(D. Wickham)

3. Inorganic Chemistry and Crystallography (cont.)

Rare Earth Ferrites - - Lanthanum manganese oxide samples were prepared under different atmospheric conditions and were analyzed by x-ray and chemical procedures. Lanthanum oxide and manganese oxide when heated in nitrogen form a compound which possesses the formula $LaMnO_3$ and has orthorhombic symmetry. Although this compound has orthorhombic symmetry, the original cubic cell has become monoclinic with with $a_1 = a_3 = 7.935$, $a_2 = 7.702$, and $\beta = 91^{\circ}51'$.

The sample formed by heating lanthanum oxide with manganese oxide in air possesses the formula $LaMnO_{3.05}$ and has the dimensions $a_1 = a_3 = 7.801$, $a_2 = 7.797$, $\beta = 90^{\circ}26'$. The sample formed in oxygen has the formula $LaMnO_{3.10}$ and has rhombohedral symmetry. The pseudocube is a rhombohedron with the following dimensions, $a = 7.690$, $\alpha = 90^{\circ}37'$. The magnetic measurements of these samples are summarized as follows:

Sample	n_B (Bohr magnetons per molecule)
$LaMnO_3$	.29
$LaMnO_{3.05}$	2.56
$LaMnO_{3.10}$	2.71

(A. Wold, R. Arnott)

Statistical Analyses - - A regression line analysis was performed on all data that has been obtained on films correlating percent Fe and H_k. The line obtained on the basis of this data is: $\hat{Y} = 15.7 + 0.38x$, where x is H_k and $\hat{Y}$ the estimated percent Fe. This equation is of course a first approximation which later data may change.

A statistical study of the relationship between thickness of films and percent Fe, H_k, and H_w has been performed for various runs. No relationship has been found to exist between thickness and the variables mentioned.

An experiment was performed to determine whether or not the annealing of films produced a good correlation between H_k and H_w. A correlation of 0.823 was found which is highly significant beyond the 1 percent level.

Etching of Thin Permalloy Films - - A number of etching experiments were performed in the usual way. A study of some small spots (1/16") was made some of which were skewed. The skewed spots on etching showed a series of curved lines. One transition spot was found which was in part skewed and in part normal.

Two monitors, one with positive magnetostriction and the other with negative were studied. The former showed etch lines at right angles to the field while the latter showed lines in the direction of the field.

A study of the effect of annealing was made and the films subsequently etched. Some of the films showed the usual etch lines while others showed almost no etch lines.

A series of films were produced in an elliptical field. Two of these films were etched and both showed twinning. The height of the twin lines was measured with an interference microscope and the height of the twin lines was 9 microinches and 10 microinches.

(U. M. Cowgill)

4. Transistor-Driven Memory

The sense winding on the 64 x 64 planes (50-30 mil cores) will have the return wires weaved into the loops from the main sense winding. In this position the two halves of the sense winding are nearly identical, so that the induced noise is uniform and small throughout the plane.

EMAR is being connected to the Address Decoder. The decoder for the scope presentation was speeded up in order to run the memory with 6 microsecond cycle time.

(G. A. Davidson)

5. Thin Film Engineering

A transformer has been installed on the induction heater in an attempt to lower the coil voltage and therefore eliminate corona in the vacuum systems. So far the results are not too encouraging.

(J. Raffel)

Work on providing a core switch for register selection of thin films has been resumed. The small ferrite core number DCL-5-195 has proved to be very well suited to this application. A drive of 1 amp-turn can produce an output of at least 100ma in a switching time that is less than 150 musec. even when driving a fairly heavy inductive load.

(S. Bradspies)

6. Fabrication Techniques

Arrangements are being made to have six experimental TDCM memory planes wired by an outside vendor. If the present assembly methods are suitable for use by vendors, consideration will be given to having quantities of these planes made outside the laboratory.

Earlier experiments on etching core-positioning forms are being resumed in an attempt to provide better core-holders.

A test plane is being wired, using #38 QF wire for the co-ordinate drive lines in an attempt to reduce wiring time.

Another butt-welder is being made for use by the vendor. Meanwhile, we are welding needles to the x,y, digit and sense wires for the six trial planes.

6. Fabrication Techniques (cont.)

The square, fixed-aperture light collimator is finished, but not tested.

The indexing jib for the evaporated-film array tester is scheduled to be completed by the 30th.

Assembly of the ARC-1 memory has started and four planes are wired together.

A miniaturized electronic package, using the plated connections, is being planned in cooperation with H. Seward, of the Instrumentation Laboratory.

Masks have been prepared for printing a 16^2 memory plane. Preliminary results are encouraging.

Tape control of one co-ordinate of the drive for the converted milling machine is being designed. This will permit patterns of discontinuous lines to be programmed and exposed automatically.

7. Transistors (This contribution was erroneously omitted from the previous Biweekly Report)

High Frequency Measurements - - A test set has been built to measure common-base rise times. It consists of a relay pulse generator, a coaxial transistor mount, and an E.G.&G. scope. Rise times of the order of 1 mμsec have been measured for a Philco L-5409 graded-base transistor.

Measurements of cutoff frequency, fh_{FE} ($\approx f\alpha$), as a function of collector voltage have been made for various transistor types. The L-5409 is the least voltage dependent of the four experimental graded-base types and the three homogeneous base types tested. (R. C. Johnston)

Tests of Sprague SB-102's - - At the request of Ken Olsen 50 Sprague SB-102 transistors were checked against the L-5122 specifications. Only 18 passed. Rejects were as follows:

18 K'_s too high.

7 V_p too low.

5 Saturation voltages too high.

2 Leakage currents too high.

(P. A. Fergus)

Transistor Life Tests - - Transistors from all operating systems have been retested recently. A summary of the transistors and their history is as follows:

Test	No. Transistors		Hours
Life test FF	32	SBT L-5122	15,000*
Direct-Coupled Shift R.	16	"	12,000*
TM-1 multiplier	99	"	15,000
TX-0 register drivers (inverters)	120	"	2,200
Shielded Shift Reg.	97	"	12,000*
EMAR	160	"	1,600
Diode-coupled Shift R	16	"	1,600
TM-1 Type shift R	125	"	11,000*
Shelf Life tests	14	"	17,000
R-C coupled Shift R	16	"	12,000*
Unshielded Shift R	99	"	11,000*
TX-0 Register drivers (emitter followers)	42	MAT L-5134	1,300

The starred items have an additional shelf life time of 6,000 hours,

Data available on these units consists of initial and present parameter measurements. In some cases important initial measurements are missing because the transistors were put into service before these tests were designed. Distributions of initial parameters, present parameters, and changes in parameters have been plotted.

One of the essential requirements necessary for evaluation of the data presently available is some idea of the power dissipation in the various groups of transistors. This has not been available. Some measurements are being made to remedy this situation. The direct-coupled FF transistor dissipates approximately $1\frac{1}{4}$ mw in the "on" condition and a negligible amount in the "off" state. In other cases the situation is not quite so simple.

Power dissipation information is essential because of the tendency of the SB contact to form solution cavities at elevated temperatures, resulting in decreased punch-through and eventual failure. The K- factor for the SBT runs about .5 to .7°C per mw. Thus 10 mw dissipation at an ambient of 75°C could mean a junction temperature of 32°C with local "hot spots" considerably above this.

No detailed breakdown of the life information is available as yet but changes appear to be of the order of magnitude and in the direction expected. Nothing has appeared which would tend to shake our confidence in the SBT as a reliable device subject to operation at room ambients and 10mw or less dissipation.

Transistor Switching - - Part II of R. C. Johnston's "Transient Response of Junction Transistors" has been published as 6M-4913 Sup. I. This deals with the effect of a field in the base region on the response of a transistor.

Part III of C. T. Kirk's paper on junction transistor switch design is in the process of being typed.

(D. J. Eckl)

8. TX-2

All the X-adder modifications have been completed, and the adder now performs a complete 18-bit addition in less than 1.2 microsecond. The difficulty with the X-register parity count circuit has been resolved, and the back panel wiring on the parity circuit is now being modified so that the parity count can be completed on less than .4 microsecond. The first and second quarters of the arithmetic element are now being wired.

The permanent power wiring system is now being tied into the TX-2 frame.

Construction of the TX-2 display system is continuing. The circuits for the TX-2 typewriter and toggle switch storage are largely completed, and the systems are now being constructed.

The possibility of cosmic rays causing random errors in transistorized computers is being investigated by Len Kleinrock.

(J. Fadiman)

9. TX-0 Programming

EEG Studies - - Several new programs for EEG analysis have now been written and debugged, in addition to the "moving window" which provides a flexible means of observation of the data.

One is the calculation of the spectral density of the data in the vicinity of the "alpha" rhythm. Our examination of the theory showed that a Fourier integral analysis can be carried out using square waves instead of sine waves if there is negligible energy in the third and higher odd harmonics of the frequencies of interest. This condition is fulfilled by our data, so that the great simplification and speed-up involved in simply adding and subtracting can be utilized. The present program is capable of resolution to about one-fifth of a cycle per second, but can be improved to one twentieth if desirable. However, constancy of the tape recorder is a limiting factor for recorded data and is under investigation. The scientific motivation for such fine resolution is to examine the constancy of frequency and phase of the alpha frequency in connection with "clock" theories of the waves such as that of N. Wiener.

In addition to the spectral density program, several others have been written to investigate the nature of the wave "in the small"; that is, over a few cycles. The alpha rhythm referred to above typically occurs in more or less regular bursts. These bursts can usually be recognized and pointed out by eye, but there has been no precise means of identifying and locating them. Such means would be very desirable to have in order to measure the burst rates, percentage of total time they occupy, etc., for different individuals under various experimental conditions. It is clear that this problem requires "pattern" or percept recognition, and is therefore of considerable interest in itself from the viewpoint of data-processing in general. Several programs have now been tried using various means of detecting and locating the rhythmic alpha bursts, and a good degree of success can be reported in agreeing with the verdict of the eye. The most successful used is a combination of peak-to-peak amplitude and (roughly speaking) zero-crossing interval properties together with suitable thresholds for discrimination. Our next step is to attempt to set thresholds automatically.

(B.G. Farley, W.A. Clark, J. Gilmore & L. Frischkopf)
(RLE)

10. Display

High Speed Printer - - A high speed printer has been received from the Haloid Corporation. This printer operates by photographing the face of a small charactron tube on a selenium drum and then transferring the image to any convenient type of paper by the Xerographic technique. At present the printer spews paper at the rate of four inches per second. Using convenient size characters this figures to four thousand characters per second.

Remote Display - - The remote display is now operating as a complete experimental unit. Test programs have been generated by WWI in Cambridge, transmitted to Building F via telephone line andto B-132 via shielded twisted pair line, and successfully displayed on the tono-typotron. During these live tests magnetic tape recordings were made of the transmission and can now be used for generating the same displays without using WWI. The fidelity of the recordings is good enough so that no difference can be detected between the line display and the resultant "canned" display.

(H. E. Zieman)

11. ARC-1

Assembly - - All assembly and detail drawings for the ARC-1 cabinet have been completed and bids have been asked for from some outside vendors for the construction and painting of the cabinet. The cabinet should be complete, hopefully, by the end of September at which time all the electronic gear will be installed. (H. E. Zieman)

Transistor-Driven Core Memory - - The Philco MAT-13 and MAT-14 core-switching transistors have been tested by V. P. Tessari and S. W. Wood of the Component Evaluation Section. These transistors were tested for the base drive requirements necessary to cause 275ma to flow in the collector at Vce= -0.3 volts at 0.5 microsecond after the application of the drive signal. The relatively high base resistance of the transistor, a "micro-alloy" structure, produced a spread in base-to-emitter voltage of -1.5 to -5.6 volts and a range in base currents between 7.4 and 33.6ma, for the MAT-14 (asymmetrical). The corresponding variations for the MAT-13 (symmetrical) are -0.96 to -5.4 volts of base drive at currents from 5.5 to 37ma.

The MAT-14 operates in the memory at a duty factor of less than 15%, so base dissipation is not too important aside from the difficulty of providing such power to the base. But in the case of the symmetrical MAT-13, the duty factor of the base drive approaches 100%, and the device dissipation in the worst unitsthen reaches 200mw in the base while pulses of collector current produce about 10mw of dissipation. Since the dissipation limit of 200mw is exceeded in some units without overdrive in the base to provide stability margins, it was necessary to select groups of the best MAT-13 and MAT-14 transistors large enough to satisfy the ARC-1 memory requirements and to design around the test limits of these groups.

Test limits of $I_b \leq 20$ma and $V_{be} \leq 3.0$v were found to accept 68% of the MAT-14's and 50% of the MAT-13's. The "H" lot of MAT-13's was particularly good. Further tests were made on these two groups to determine the base voltage necessary for 150% and 175% of the minimum base current, or 30ma and 35ma. The MAT-13's required 5.5v or less for 30ma and 6.2v or less for 35ma, while the MAT-14's required 4.8v or less for 30ma and 5.5v or less for 35ma. As a result, it was decided to design to a 30ma base drive which will limit the MAT-13 base dissipation to 144mw.

In contrast to other parameters, the base resistance seems quite uniform from unit to unit. As a result, no reduction in base dissipation is gained by varying the base drive source resistance, and a convenient current-source drive circuit has been designed. The MAT-13's will be coated with 12,500 cs Silicone oil and mounted in the edge of a $\frac{1}{4}$" aluminum plate for the best possible cooling of the units.

As a result of these tests, the READ/WRITE DRIVER has been tested with limit transistors from the selected group and isnow felt to be ready for production on etched cards. The READ/WRITE/INHIBIT GENERATOR can also be released now for production since its output requirements are stabilized with the completion of the READ/WRITE DRIVER.

(W. F. Santelmann, Jr.)

<u>Clock Pulse Generator</u> - - A transistorized clock pulse generator is being designed for the ARC-1. Experimentation with Philco MAT-14 core switch and General Transistor 2N317 transistors has produced 3-volt, 0.1 microsecond pulses at a load current of 150ma and a rate of 800 kps. Two rather knotty problems remain, one the increase in pulse width at load currents less than the maximum, and the other the design of efficient 0.1 microsecond pulse transformers to minimize the waste of pulse power. I have also assumed the problem of locating a crystal oscillator operating at 800kc with a stability of about one part in 10^6 in 15 minutes. Commercial estimates run between $400 and $500. I am therefore constructing an

oscillator using an inexpensive 800kc crystal mounted in a James Knights oven. The stability over 15-minute periods will be determined by comparison with WWV by means of lissajou patterns.

(John Teele)

K. Olsen

Division 6 - Lincoln Laboratory
Massachusetts Institute of Technology
Lexington 73, Massachusetts

Group 63
Inter-Office Memorandum

To: W. N. Papian,

From: Marvin Epstein M. A. Epstein

Subject: THE SUMMER STATISTICAL SESSION ON RELIABILITY AT ENDICOTT HOUSE, August 8, 9, 1957

Introduction

On August 8 and 9, 1957, I attended the Summer Statistical Session on Reliability. This was a small meeting (attendance about 20) with the purpose of having a lively informal discussion among people working in the field of reliability. The majority of those attending were statisticians and not engineers, so that much of the emphasis was placed on the mathematical problems of statistics and life testing rather than on the problems of engineering design. At the moment, the statisticians, like everyone else, lack the data to analyze. Also, there are many problems associated with analyzing, interpreting and using the data that is available. On the other hand, there is a serious effort to solve the mathematics involved and there were, as well, a number of interesting ideas proposed in the discussion. Hopefully, in the future there will be data available on the old components (and perhaps some of the new components) so that one can use the techniques discussed here to obtain good predictable life in the components, as well as a firm statistical basis for design decisions.

The Discussions

The meeting was divided into four discussions which were led by discussion leaders.

The first discussion led by Mel Allen, a private consultant statistician formerly of RCA, was related to the problems of accelerated life tests. The basis of the discussion is the well-known assumption that the life of capacitors varies inversely with the voltage raised to some power b, where b is a constant between 2 to 6 depending on the particular type of capacitor. $L = kv^{-b}$. This assumption of acceleration with overvoltage was used in the Sage system life tests and is the basis for the Mil Specs tests of capacitors at voltages and temperatures both higher than intended for normal use. Thus, if the test voltage is twice as high as the circuit voltage and b = 5, then 1000 hours test life represents $2^5 \times 1000 = 32{,}000$ hours of life.

The speaker assumed the above relation between life and voltage was true, and he discussed a test where the test voltage was linear in time rather than a constant. Thus, one has a test where the acceleration of life is not constant; in fact, when the test voltage is less than circuit voltage each hour of test represents less than an hour of life, and when the test voltage is higher than circuit voltage each hour of test represents more than an hour of life (as seen by the formula). Since this type of test is a distortion as well as a speeding up of the life, Allen carefully stated that the purpose of the test was to estimate expected life and not to estimate test life. Thus, he developed the necessary statistical formula to translate test data into estimates of expected life distribution. He is analyzing test data of this sort for a commercial concern which has run data on both the acceleration test and ordinary life tests at rated voltage. So far the derived equations check and the tests are continuing. When asked about the possible acceleration, the speaker said that one could think of accelerating years into hours but that in practice lower acceleration would be more trustworthy. When questioned about testing production lots to see if the lot was satisfactory, he said that one would need an initial large test to evaluate the process and then a small sample could be used to accelerate and evaluate each lot.

The second report by Joan Rosenblat of the National Bureau of Standards was an attempt to describe the way transistor characteristics drift with life. She discussed various ways of describing the drift of component characteristics with time. Among the descriptions proposed was a family of curves describing how long it takes a component to drift beyond a given tolerance. There was a discussion of some of the mathematical problems, such as the fact that one wanted data on the continuous curves but measurements are only taken at fixed intervals and it is impossible to say for certain that a component that is within tolerance at the beginning and end of a period would not have failed during the period. This is an attempt to statistically describe and measure the very important design consideration as to what is the variation of life or failure rate as the tolerance to drift is increased. Clearly this dependence depends on the behavior of the component. If the component spends a lot of time on the average going from 5% to 10% tolerance, it pays to increase the tolerance from 5% to 10%. If, on the other hand, a component after it reaches the 5% value drifts quickly past the 10% value, it isn't worth much to increase the tolerance. The speaker has attempted to apply these ideas to some transistor tests in the National Bureau of Standards. Evidently they do not have transistors from a stable process and the tests are very drastic besides, so that there was not much data other than the fact that high temperature etc. can kill these particular transistors quickly. There should be some interest in these ideas because of the importance of the question of design tolerance of single components and groups of components. In my opinion, it might be more sensible to try this approach on better behaved components to start with. Precision resistors used for accurate dividers might be a useful area of investigation.

The third report was given by a member of Vitro and described mostly typical system design ideas concerning reliability. He mentioned that one could estimate failure rate of a system by adding the estimated failure rates for all the components. He said that this method would allow a prediction of failure rate in military equipment within 20%. Most of the ideas were not new. Amusing to those familiar with the Lincoln philosophy on system design was a comment by Harris Tall, who is an administrator in RCA reliability. He said that it was much more expensive to put a system together with unreliable components than with using reliable components (even if total system reliability demands were low) as it is very hard to get many pieces of unreliable equipment to operate simultaneously.

The fourth and last report by a member of the IBM group working on Sage reliability discussed sequential testing. In many tests one plans the tests in advance and then evaluates the data when it is all in. However, sequential techniques discuss the case when one does tests in sequence with various choices at each step and so before each new test one can use the past data to choose among the alternative choices. It seems reasonable that one can shorten the test time by using the past results to make the new tests better chosen for the task at hand and thus home in on the answer. The paper discussed two examples of the sequential testing method. In one example there are two types of test (like testing one of two components) and one wants to come to a decision (like which component is better). Then assuming one makes tests in sequence (tests one component type at one time) one can use the past results to see which test will be more informative. This idea might be important in choosing among several alternatives in design. The second example concerned the problem of choosing an optimum operating point. As an example, he chose the XD-1 marginal checking system. Clearly, a computer that is checked all the time is not useful. On the other hand, a system that is marginal checked at very rare occasions is not getting full benefit of the marginal checking. So there is a clearly defined best distance between marginal check times, and the situation is obviously too complicated to analyze for the correct answer. The proposed answer is to run the system for a while with a given time between marginal check periods and then choose a different time between marginal check periods. By using the data from each of the previous rates of marginal checking, he has a formula that will tell what rate to do marginal checking in for the next test. He proved (I didn't understand it all, but he said it was an outline of a proof) that using his formula for choosing the rate of marginal checking for the next test, the rate that would maximize utility would be quickly approached and, in the limit, the optimum marginal checking rate would be the system rate.

MAE:mk

Distribution:
Group Leaders, Groups 62, 63, & 68.
Section Leaders, Group 63
Staff Members of Transistor, Terminal Equipment, Computer Engineering, and Memory Sections

Ken Olsen

Issue XXI

GROUP 63 BIWEEKLY

(Period: 10 August to 23 August 1957)

SUMMARY

This period's report contains items under the following titles:

[signature]

Distribution:

Group 63 Staff
Division 6 Group Leaders and
Assoc. Group Leaders
Division 6 Editorial Office

1. Physics

Measurements -- The present sample-holder arrangement was found to be unsuitable for paramagnetic susceptibility measurements of samples as a function of temperature because the magnetic impurities within the holder has a moment of the same order as that of the sample. Sample holders of high purity copper and teflon have been ordered to overcome this problem.

Further investigation of the transition properties of single ferrite crystal No. 2 has been started. No change in the magnetic moment of the sample is observed on cooling through the transition temperature. This would seem to eliminate the possibility of a Yafet-Kittel transition in which the tetrahedral and octahedral sites split up into sub-sites and the magnetic spins on each sub-site are aligned in a different direction. On the other hand, the marked change in the anisotropy below the transition is found to depend upon the orientation of the crystal in the magnetic field when being cooled through the transition. The direction of the applied field becomes the easy direction. However, when the field is applied in the 100 direction, the resultant anisotropy configuration is unstable.

(N. Menyuk and K. Dwight)

Thin Films

Fast Switching -- A very clean fast switching signal has been obtained in the 1-10 mμs range at the expense of a reduction in signal output of about a factor 3. An attempt will now be made to regain the former sensitivity.

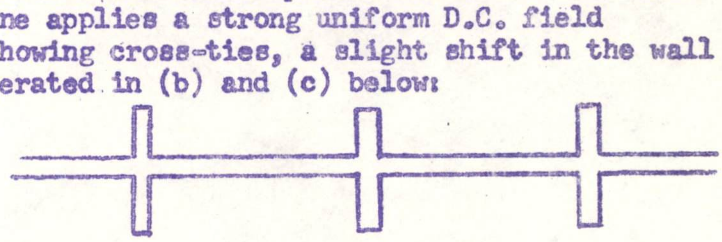
(G.P. Weiss)

Production of Thin Films -- A photoelectric transmission densitometer has been ordered. It is hoped that this instrument will permit quick, nondestructive thickness measurements of thin permalloy films. The manufacturer claims a density range from zero to five through a 1/16" diameter aperture, which should permit measurement of films up to 1500 Å thick.

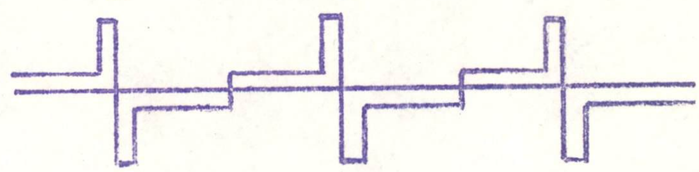
(F. S. Maddocks)

Domain Walls -- A new effect in the magnetic domain patterns of permalloy films has been observed which helps to bear out the theory that the cross-tie phenomenon is related to a wall magnetization which spirals about the wall axis with distance along the wall. If one applies a strong uniform D.C. field perpendicular to a powder pattern showing cross-ties, a slight shift in the wall pattern is observed, as shown exaggerated in (b) and (c) below:

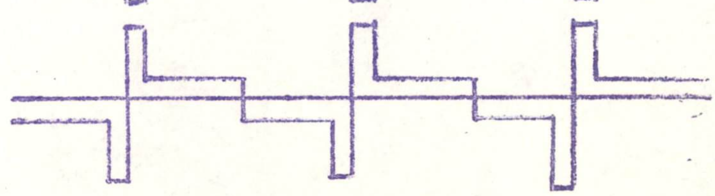
a. Original pattern



b. Field perpendicular to plane of film.

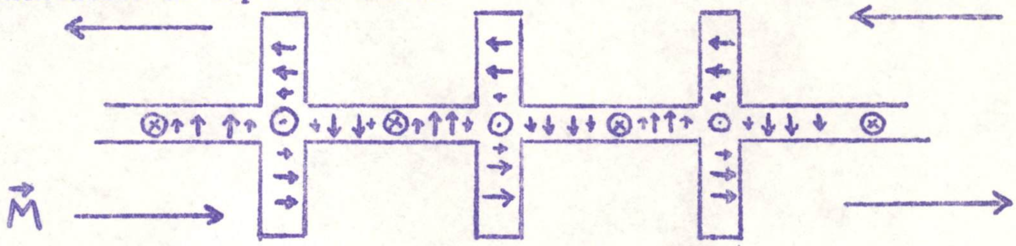


c. Field in (b) reversed.



Domain Walls (cont)

If one postulates that the colloid is polarized into vertical dipoles by the vertical field, and that these dipoles are attracted only to those portions of the poles along a wall having the proper sign, then a shifting wall pattern is obtained with field reversal if the magnetization in a wall has the orientation as depicted below:



This pattern, of course, is idealized but it seems obvious that some kind of spiraling or reversing structure is definitely indicated by this experiment.

(E. E. Huber, D.O. Smith,
J. Goodenough)

2. Ceramics

Switch Cores -- The preparation of a zinc-magnesium-manganese ferrite core with a low value for S_w, first prepared several years ago, is being repeated as a first step toward an improved switch core.

Filter Ferrites -- A higher value for a magnetomechanical coupling coefficient has been observed for the composition $Fe^{3+}\left[Ni^{++}_{0.98}Co_{0.02}Fe^{+++}_{1.00}\right]O_4$, sintered at 1200-1300°C, than is exhibited by any presently available commercial ferrite core. Several process variables are being investigated to further increase the value of this coefficient.

Production -- 161,480 regular memory cores have been pressed. Fifteen thousand zinc containing cores have been pressed and fired.

(C. O. Dugger)

3. Inorganic Chemistry and Crystallography

Chemical Analyses of Thin Permalloy Films -- Four sets of thin permalloy films were produced under different conditions. Set I and II were contributed by K. Shoulders and were produced by electron bombardment of a melt placed 5.5 inches from the substrate. Sets III and IV were produced on J. Raffel's evaporator where an 83-17 melt was placed 13 inches from the substrate. The conditions (temperature of melt and substrate, composition of the melt, and pressure during evaporation) for sets III and IV were the same save that set IV was performed with a 0.25 inch alundum orifice suspended on the melt. Set III was produced in 55 seconds while IV was performed in 13 minutes and 58 seconds. All films analyzed were 2000 Å thick. The usual correlation coefficients (r) were determined for sets III and IV but not for sets I and II since these were not produced in a field. The results are given below:

Chemical Analyses of Thin Permalloy Films (cont)

No.	I % Fe	I % Ni	II % Fe	II % Ni	No.	III % Fe	III % Ni	IV % Fe	IV % Ni
1	37.10	62.90	40.56	59.44	1A	17.44	82.56	17.17	82.83
2	33.42	66.58	35.26	64.74	1B	17.53	82.47	17.23	82.77
3	34.88	65.12	34.78	65.22	1C	17.66	82.34	18.32	81.68
4	35.48	64.52	33.79	66.21	1D	17.34	82.66	17.58	82.42
5	31.45	68.55	32.55	67.45	2A	17.17	82.83	17.11	82.89
6	34.78	65.22	34.58	65.42	2B	17.09	82.91	17.17	82.83
7	44.99	55.01	44.99	55.01	2C	17.37	82.63	17.17	82.83
8	40.04	59.96	40.74	59.26	2D	17.27	82.73	17.11	82.89
9	40.82	59.18	38.75	61.25	3A	17.34	82.66	17.23	82.77
					3B	17.32	82.68	17.03	82.97
					3C	17.51	82.49	17.17	82.83
					3D	17.28	82.72	16.96	83.04
					M	17.25	82.75	17.03	82.97
Total % variation		13.54		11.21		0.57		1.36	

Relationship	Correlation Coefficients III	Correlation Coefficients IV
% Fe and H_k	0.919++	0.995++
% Fe and H_w	- 0.080	0.623+
H_k and H_w	- 0.160	0.153

Note:

++ Significant at or beyond 1 percent level.

+ Significant at or beyond 5 percent level.

(Ursula M. Cowgill)

4. Core Testing

F-398 Core Handlers -- The revised model of the first core handler is now operating. This machine requires excessive maintenance to keep it operating because ferrite powder accumulates under the rotating plate, eventually binding it. The track also wears excessively and has to be reground. The contacts are now working quite well and require minimum balance. A four hour testing time is about normal for an eight hour day, and approximately 6,000 single-tested cores can be tested in this time.

The "improved" model (second core handler built) is now in the division VI shop being rebuilt. A new type plate will be tried, to eliminate the ferrite dust problem. Two new type contacts will also be tried. We hope this machine will then operate with less breakdown time.

Approximately 16,000 cores were given to Hilda this week to be delivered to A. Koch. This makes approximately 50,000 F-398 double-tested cores delivered to date.

(R. C. Zopatti)

5. Transistor-Driven Memory

The address decoder (1st level decoder), and core driver (2nd level decoder and level amplifier) plug-in units are being checked out in the frame.

One of the problems encountered was the reverse current which flows in the selection line when the selection line switch is turned off. Ways of limiting the reverse current are being investigated.

(George Davidson)

6. The Big Memory

The marginal checking system has been installed and checked out. A complete set of margins and operating schmoos will be run as we are able to get computer time on TX-0.

(D. H. Ellis)

7. Thin Film Engineering

Corona in the bell jar has been eliminated by introducing a ground plane in the vicinity of the heating coil.

An 8 x 8 spot tester has been constructed which appears promising.

(Jack Raffel)

A thin film driver using four 5134 transistors has been designed, built, and tested. It can put out a 160 mμsec pulse of 80 ma, or a 200 mμsec pulse of about 115 ma., and will supply both read and write pulses, to drive a switch core for register selection.

An equation that was developed for the prediction of switching time of a core as a function of the secondary current, the secondary turns, and the unloaded switching time, proved to be accurate within ± 5 per cent and proved to be very useful in the final design of the driver.

(Sydney Bradspies)

8. Fabrication Techniques

A. Koch, Cambridge vendor, has begun work on an order of six TDCM planes.

In the absence of a suitable core-loading jig of the 4096-core size, an alternative method is being tried which shows considerable promise. Sixteen individually loaded groups of 256 cores each, are assembled to form the 4096-core array for wiring. Another method ready for trial, uses etched plates of hard copper to position the cores.

A 16^2 printed plane has been exposed and 4 conductors successfully printed through each of the 256 cores.

(E. A. Guditz)

9. TX-2

During the past biweekly period a complete set of testers for the plug-in units for the TX-2 central machine has been completed. This will

TX-2 (cont)

greatly facilitate the testing of these units.

The design of a delay circuit has been completed by Len Kleinrock, and it is contemplated using this circuit in the In-Out equipment of TX-2.

The checkout of the M and N register, M and N parity circuit, X register, X parity, and X adder has all been completed. Accurate measurements have been made to determine the pulse current required in each part.

Ken Konkle attended the Philco meeting in Philadelphia where specifications for the L-5122 and L-5134 transistors were discussed. He also went on a trip to survey the transistor manufacturing industry on the West Coast.

(J. Fadiman)

10. TX-2 Programming

A basic input-output translation program is being designed for TX-2. It will be able to convert information from paper tape or the IBM direct input typewriter. The translated information will be stored directly in its assigned memory location and/or recorded on paper tape. An interrogation print-out will also be available. The program will serve as a utility system for the first test programs and also the more elaborate utility programs. Its main value, however, will be in acquainting yours truly with TX-2 and its operation code.

(Jack Gilmore)

11. Transistors

K-factor tests -- Initial measurements have been made by P. Barck on the Philco core switch transistors with and without a heat sink. Without the heat sink the K-factor was 0.4°C per mw. With the heat sink this was reduced to 0.26°C per mw. The heat sink was an aluminum block 2" x 1/4" x 1/2" into which the cap of the transistor was inserted.

The power dissipation which may be tolerated in this transistor depends on the life expectancy at high temperatures which has not been determined. The L-5134 which is also a microalloy transistor will stand storage at 100°C. However, we know from experience that 100°C storage is not the same as 100°C produced by power dissipation. The latter condition is worse, Suppose then we allow a 60°C rise which gives a junction temperature of 85°C, not necessarily a safe value. This would mean an allowable dissipation of 230 mw with the heat sink.

There is however one other very important consideration. A maximum of 300 μa at 30 v has been placed on I_{co} at room temperature. I_{co} doubles for roughly every 11°C increase in temperature. If this rule held this would mean a leakage current of 9.6 ma for a limit transistor at 80°C. Fortunately, all of the leakage is probably not I_{co}, a considerable part probably being surface leakage which does not follow the same temperature relation. A unit, for example, which had a leakage of 11μa at 30 v and 85°C. Only some 17 percent of the units have initial values this low. Further tests are being conducted.

(Donald J. Eckl)

12. Display

High-speed Printer -- The mount for the 7-inch charactron on the high-speed printer has been finished. Work continues on the driving circuits for the

Display (cont)

tube. The paper drive control of the printer does not seem satisfactory for random start-stop operation and some modification will be made.

It was my understanding that the fusing heater in the printer was to have a higher than normal voltage for a short time when it came on in order that it would heat up quickly. It now starts up with the lower voltage and switches to the higher after a short delay. This could be a wiring error or a design change to compensate for the change in resistance as the heater gets hot. We have not yet received schematics and instruction manual from Haloid.

(R. H. Gould)

13. Personnel

New personnel in Group 63 include Terry Herndon, Staff Member in Dick Best's section, Nicola Iodice, technician in Ben Gurley's section and Joel M. Joel, technician in Jack Mitchell's Memory Lab.

Terminations

There were three terminations during the last bi-weekly period: James Pugsley, Edith Jeffrey, and Alex Valm.

(M. Keene)

Ken Olsen

Issue XVII

GROUP 63 BIWEEKLY

(Period: 15 June to 28 June 1957)

SUMMARY

This period's report contains items under the following titles:

WNP

Distribution:
Group 63 Staff
Division 6 Group Leaders and
Assoc. Group Leaders
Division 6 Editorial Office

1. Physics of Magnetic Materials

Measurements - - The determination of the Curie temperature T_c of a series of lithium-nickel oxide samples was completed. With the exception of one sample which had a Curie point below 77°K, all the samples had a value of T_c between liquid nitrogen and room temperature.

The magnetic moment of a series of samples of composition $LaNi_xMn_{1-x}O_3$ with different values of x were determined at liquid helium temperature. The samples were found to be magnetic and the hosannas rang out in room C-109. The results have been turned over to A. Wold.

The magnetic moment of single crystal sample No. 1 has been measured from + 100°C. to - 196°C. The results of this measurement indicated the sample is essentially identical with sample No. 3. Anisotropy measurements being carried out over this temperature range corroborate this conclusion. The magnetic moment of this sample as determined at liquid helium temperature indicates it has a magnetic moment of approximately 3.8 Bohr magnetons per molecule. This result leads to the conclusion that the sample is nominally manganese ferrite, but very far off stoichiometry.

(N. Menyuk and K. Dwight)

High Vacuum (Correlation between coercive force and iron-content in evaporated permalloy films) - - It is well known that the coercive force of thin ferromagnetic films depends very much on the chemical composition. At a thickness of about 1000 Å, a pure iron film has $H_c \simeq 300$ oe, pure nickel $H_c \simeq 150$ oe. and permalloy a few oersted. It would be very interesting to know the composition where the minimum of H_c occurs. Therefore, it was tried to analyze the experimentally found curve, $H_c = f$ (% iron) mathematically by correlation calculations to see both, where the position of the minimum in predicted leads to the parabola $(x - 17.32)^2 = 2.39\ (Y - 3.10)$, the minimum being at $H_c = 3.10$ oe, 17.32 percent Fe. But the upper part of the slope of the experimental curve is a straight line, and a parabola cannot reflect that. By neglecting the two highest points, one gets another parabola with the minimum at $H_c = 4.96$ oe and 17.81 per cent Fe. This parabola fits better to the experimental values near the minimum. The cubic equation $Y = - 0.042\ x^3 + 3.371\ x^2 - 83.04\ x + 652.15$ (minimum at $H_c = 4.76$ oe and 19.03 per cent Fe) yields the best correlation coefficient of 0.9981, but this curve gives only the best fit in the region under consideration, while the parabolas mentioned above extend somewhat further. In spite of the fact that at the present moment we do not have enough experimental values to undertake a thoroughly mathematical analysis, the calculations given above show where the minimum of the coercive force is to be expected: at approximately 5 oe. and a composition near 18-82 FeNi.

(Klaus Behrndt)

Thin Films - - The General Radio Balun Unit has been tested in our switching apparatus and we have obtained balance in the frequency range from 250 to 900 mc. Resonance measurements will be made as soon as the apparatus is mounted in a mumetal shield designed for this purpose. (G. P. Weiss)

Interesting and unusual domain patterns have been observed on thin films by use of the Bitter technique. These patterns probably indicate a domain and wall

1. Physics of Magnetic Materials (cont.)

structure not previously reported. Further experiments are being carried on in order to try to explain the fundamental nature of these walls.

(Ernest E. Huber, Jr.)

2. Ceramics

Filter Ferrites - - Samples in the system $Fe^{+++}\left[Ni^{++}_{1-x}Co_xFe^{+++}\right]O_4$ have been prepared where x varies from 0 to 0.02 and x is 0.05. The magneto-mechanical coupling coefficient for samples fired at 1350° varies from 0.006 to 0.49.

Yttrium ferrite - - Yttrium ferrite, $Y_3Fe(FeO_4)_3$, toroids have been produced with a density 97.5 ± 1.0 per cent of the theoretical (5.17). Continued efforts will be made to raise the density of these bodies to ca. 99 per cent of theoretical.

(C. O. Dugger, E. Larson)

3. Inorganic Chemistry and Crystallography

The System $M^{+4}_{1-x}Mn^{++}_x\left[Mn^{++}_{2-x}M^{4+}_x\right]O_4$ - - Small saturation magnetic moments have been observed for substances containing several M^{+4} cations; however, a material has not been prepared successfully yet that exhibits a large enough magnetic moment to establish definitely that there is an exchange interaction between manganous ions on the two kinds of lattice sites in the spinel. A cobalt analogue of the above composition has been prepared and shown to crystallize as a cubic spinel, the composition $Ge^{4+}_{0.2}Co^{++}_{0.8}\left[Co^{++}_{1.2}V^{4+}_{0.8}\right]O_4$. Magnetic measurements indicate no Co^{++} - Co^{++} interaction.

(D. Wickham)

Thin Film Analysis (Angular Effect of Thin Permalloy Films) - - An experiment was designed to determine whether or not a radial distribution of Fe and Ni occurs when an 80-20 melt is evaporated onto circular spots of glass at a distance of 12 inches from the melt. The films were 2000 Å thick. The position of slides during evaporation was as usual (see previous biweekly reports). The per cent Fe, per cent Ni, H_k and H_w were determined and the results are given below:

No.	Per cent Fe	Per cent Ni	H_k	H_w
1A	18.85	81.15	10.38	2.82
1B	18.65	81.35	10.00	4.86
1C	21.35	78.65	13.25	3.80
1D	18.42	81.58	9.70	3.28
1E	19.95	80.05	11.10	3.62
2A	18.20	81.80	8.60	1.90
2B	18.06	81.94	8.53	3.85
2C	18.61	81.39	10.00	3.06
2D	18.80	81.20	10.30	2.53
3A	18.69	81.31	10.00	4.08
3B	18.36	81.64	9.10	2.95
3C	18.42	81.58	9.73	1.82
3D	18.70	81.30	10.10	1.81
Monitor	18.85	81.15	--	--

3. Inorganic Chemistry and Crystallography (cont.)

A statistical correlation study was also performed. The correlation coefficients [r] for the various relationships are given below.

Relationship	r
Per cent Fe and H_k	0.954
Per cent Fe and H_w	0.282
H_k and H_w	0.225

Air Contamination Study - - Since a monobed has been bought in order to give us purer water, it was desirable to check water of various types for Fe content. The results are given below:

Substance	p.p.m Fe
3rd distillate from glass still	0.12
Monobed H_2O exposed at night with all doors and windows closed	3.05
Monobed H_2O exposed during daytime, 4 hours	6.09
Monobed H_2O exposed during daytime with ceramic lab closed, 4 hours	5.35
Monobed H_2O fresh from monobed	0.00

(Ursula M. Cowgill)

4. The 2½ Megabit Memory

The marginal checking control panel has been completed and plans are being made to change the rack wiring to conform to the marginal check system.

(D. H. Ellis)

5. Transistor-Driven Memory

Malfunctions in the Plane Tester have prevented testing of the 50/30 mil core planes. The unit is now operating satisfactorily and the tests are being made to determine operating areas at various currents.

The logic for the "T" memory has been checked out. One plane is being mounted on the frame. Testing will be done in a new room, next to the TX-0 computer room, which should be ready by the middle of July.

More tests on the General Transistor 2N317 (pnp) indicated that it has a very high forward beta (40 to 100) at 250 ma. of collector current and 0.2 volts from collector to emitter. The inverse beta is around 10 at the same current level; however, as was previously reported, the unit has a low punch-through voltage.

The General Transistor GT904 (npn) has a high forward beta at 1 ma., and a low inverse beta. They have not been checked yet at higher currents.

(G. A. Davidson)

5. Transistor-Driven Memory (cont.)

The wiring of the test plane into TDCM is progressing and should be complete in a few days.

(D. H. Ellis)

6. Fabrication Techniques

Various techniques of modifying the core holding jigs pressed on the undersized mold are under investigation in an effort to obtain jigs that load satisfactorily. At this time no satisfactory jigs have been made. Bids and delivery dates for a new mold are being obtained.

(J. L. Mitchell)

7. Thin Film Memory

Relocation of thermocouples on the substrate heater has eliminated the incorrect temperature readings which had led to overheating and oxidation of films in previous runs.

Calculations have been made to determine the field distribution around various configurations of drive lines.

A number of 8 x 8 and 16 x 16 planes have been made in which the easy axis appears to be slightly skewed. Possible causes are the field due to the substrate heater, magnetostrictive effects due to stresses in the glass during heating, or poor surface conditions.

The first 8 x 8 plane is about to be tested in the "old" memory plane tester. This will enable us to view for the first time a raster of a full plane operating under dynamic conditions.

Preliminary work has been started on printed circuitry for drive lines.

Dick Zapotti is assembling a tester to provide the pulse sequences necessary for film testing.

(J. I. Raffel)

Work on design of device for measurement of switching time as a function of driving current for films has been completed.

Work has begun on design of driving circuit for thin films.

(S. Bradspies)

8. TX-0 Programming

A program which calculates a moving average of the EEG data has been written and debugged. It is first used to smooth the data and then find a base line. Phil Peterson is writing a program which will use the base line and smoothed data to find the frequency of zero crossings. The information obtained will be displayed in a histogram display.

A program is being written for Jack Raffel which will display various magnetic fields about a thin-film surface and calculate and display the resultant field. The choice of fields to be entered into the display and calculation is controlled externally by toggle switches.

(J. T. Gilmore, Jr.)

9. Display

I spent most of the week of 17 June at Hughes Aircraft Company, Culver City, California, observing tests and demonstrations of a 19 inch character-writing half-tone storage tube. This tube, which has a bright display with a controllable persistence up to about one minute, is to be used for the Remote Display. Although not perfect, the tube appeared adequate for our experiments and it was decided that I should bring it back. Because of the cost and uniqueness of this tube we decided, with the agreement of the airline, that I should bring it as baggage and supervise its loading and unloading to minimize the chance of damage. I made a reservation on a through plane to Boston and arranged a rendezvous with the tube at the Los Angeles airport. The tube never appeared. By ten minutes before plane time there were three Hughes men, three American Airlines men, and myself dashing somewhat confusedly around the airport looking for a large wooden box. I boarded my plane at the last minute and as the hatch was closing I was told that the box had been put on an airfreight plane and would be held at the airport in Boston. Visits to Logan Airport the next day and the next disclosed no one with any knowledge of the tube although the plane it was said to have been on had come and gone. A call to Hughes produced no information, but they promised to start a search.

This all started on Monday and today, Friday, the large wooden box appeared courtesy of Air Express. Where it has been and why it fell into their hands we have yet to find out. The tube looks OK and electrical tests will start soon.

(R. H. Gould)

10. ARC - 1

A 256-register, 18-bit word, core memory is to be built for ARC-1 using completely transistorized circuitry. Fortunately, the circuit problems diminish with the size of the memory, so that many of George Davidson's transistor circuits which operate a 64^2 memory with difficulty appear to be adaptable to operating a 16^2 memory with ease. Accordingly, the design of the ARC-1 memory is leaning heavily on Davidson's work and experience.

Blocking oscillators are being designed to provide the waveforms required for the read, write, and inhibit functions. The read and write oscillators will operate into Davidson-type read-write drivers which are also being designed.

A blocking-oscillator has been designed to trigger the EPSCO Model B DATRAC used in the ARC-1 from a TX-2 3-volt pulse. It is now being built for evaluation.

(W. F. Santlemann, Jr.)

K. H. Olsen

Issue XVIII

GROUP 63 BIWEEKLY

(Period: 29 June to 12 July 1957)

SUMMARY

This period's report contains items under the following titles:

John B. Goodenough

Distribution:
Group 63 Staff
Division 6 Group Leaders and
Assoc. Group Leaders
Division 6 Editorial Office

1. Ceramics

Memory Cores - - Experimental memory cores in the composition system $2Mg\,Fe_2O_4\,]_{0.87-x}\,[Zn\,Fe_2O_4]_x\,[3MnO]_{0.13}$ where $0 \leq x \leq 0.25$ and $\Delta x = 0.05$ have been prepared. The results of early testing are the following, compared to regular memory cores.

Sintering Temp.	Compn.	Undisturbed Voltage Output	Disturbed Voltage Output	Driving Current for Read and Write	Driving Current for One-Half Write	Switching Time Coefficient	Avg. Grain Size
~1290	x = 0 Reg. Mem. Core	60-65	10 m.v.	460 m.a.	270 m.a.	1.13 µsec./cm.	11.0 µ
~1175	x=0.025	80-100	10-20	360	190	0.8	5.3

Experiments will be continued to reveal optimum composition and sintering temperature for the preparation of a satisfactory low-drive memory core.

Equipment - - Allen Spurr and Richard Germann have developed a sieve shaking machine which has appreciably reduced the time required to carry out sieving operations. The sieve screens are expected to be useful for longer times before wearing out.

(D. G. Wickham)

2. Inorganic Chemistry and Crystallography

Rare Earth Ferrites - - Analytical procedures have been developed for the chemical analysis of the system $La\,Mn_xNi_{1-x}O_3$. Preliminary magnetic measurements indicate a moment of 3.1 Bohr magnetons per molecule for the sample $La\,Mn_{.8}Ni_{.2}O_3$ prepared at 1350°C in air. At this composition x-ray diffraction patterns show the existence of a single phase.

(A. Wold)

Mixing of Permalloy Melt - - A clean glass plate was placed at a 45° angle above a permalloy melt, which in turn was covered by the evaporating melt, in order to determine visually whether or not mixing was apparent. Slag was moving around the edge of the melt and on cooling concentrated in the center. A relative reading with an optical pyrometer was taken just after the RF unit was shut off. The temperature of the center of the melt was 1295°C while that of the edge was 1315°C.

Oxide Experiment - - A fresh monitor slide, 2000A° in thickness, was divided into 3 equal portions. Portion I was analyzed immediately, portion II was immersed in benzene and portion III was exposed to air for 8 hours. The length of time required for dissolution and the acid used are given below.

Portion	Time of Dissolution	Type of Acid Used
I	8 hrs.	GN HNO_3
II	8 hrs.	GN HNO_3
III	No dissolution in 3 days	GN HNO_3
	10 min. when HCl was added to the HNO_3	HCl

2. Inorganic Chemistry and Crystallography (cont.)

Etching of Thin Permalloy Films - - Etching of thin permalloy films has been accomplished with thickness ranging from 1000A° to 15,000A°. The latter apparently show regular etch figures corresponding to 2 or 4 fold axes. The thinner films, 1000A° - 2000A°, that had been produced in a uniaxial field showed etch lines, in all cases tested, at right angles to the field. Films studied that had been produced under a rotational field indicated many etch lines but no two lines were in the same direction.

(U. M. Cowgill)

3. Thin Film Memory

Several simple circuits for driving a line in a thin film memory have been tried. The results have not been bad, but they are not yet good enough to use. The time constant of the load is so long that it is difficult to get the desired current wave shape and still work within the ratings of the 5134 transistor. The size of the pulse required at this base of the output transistor is very large and could not be supplied by one other 5134 transistor.

(S. Bradspies)

A first look at the 8 x 8 wired array for testing films confirms our feeling that sensing is going to be one of our major problems. With driver rise times faster than 0.1 microseconds and signal levels at about 1 millivolt the noise transients encountered are quite severe. Work in the next few weeks will be aimed at analyzing this problem more thoroughly.

Uniformity of evaporated films is somewhat more encouraging. Some early experiments which indicated skewing of the easy axis turned out to be false alarms due to improper shielding from the earth's field.

(J. I. Raffel)

Thin Film Hysteresis Loop Tester - - A new unit has been built by Sharpe Plastics that has gear driven adjustments. This will now have to be installed and tested.

Thin Film Pulse Tester - - The driving logic for pulse testing films is being built.

(R. C. Zopatti)

4. The 2 1/2 Megabit Memory

The wiring changes necessary for the installation of the marginal checking system are under way.

We are experiencing memory parity errors largely due to current driven tube problems. Cathode flaking and tap shorts are contributing to the major number of memory failures. Also, it has been found that the current supply for bias to the magnetic-core switch is temperature sensitive and varies as much as 100 ma. over a twenty-four hour period. We are investigating the circuit for redesign to eliminate the problem.

(D. H. Ellis)

5. Fabrication Techniques

A number of core-loading jigs were molded using a latex material. The latex jig is stretched over a centered metal plate and then used in the conventional manner. The stretching opens the undersized holes in the jig enough to allow the cores to be positioned. This type jig loads fairly well; about a half-dozen cores must be positioned by hand. A new mold is being fabricated by an outside vendor and Division 7 is investigating the problems of repairing the existing mold.

(J. L. Mitchell)

6. Transistor-Driven Memory

Trouble with the Plane Tester has prevented the plane testing procedure for the 50-30 mil cores to be established. The impedance of the selection line was reevaluated on a plane with good cores. The previous impedance had been determined from the digit winding with the rest of the plane floating. Grounding the selection lines changes the digit winding impedance considerably; therefore, the actual selection winding of an operating plane was measured to find the equivalent load.

Since the General Transistor 2N317 has low breakdown voltage, some 2N316's have been ordered to investigate their characteristics at 250 ma. currents and 30 volt diode voltages. The General Electric 4J D1D1 has a current-gain of 4 to 20 at 250 ma.

(G. A. Davidson)

Core Handler for F-398 Memory Cores - - The core handler for the F-398 memory cores with the latest improvements has been installed and is now being tested. The contacts of the handler have been redesigned so that we might quickly take and clean them. The ground contact has been eliminated by using flexible leads. It is hoped these improvements will greatly reduce breakdown time.

Manual Core Handling Jig - - A jig for pulse testing single ferrite cores has been built. It has a two-conductor probe (one inside another) with a dummy probe for cancelling purposes. The initial attempt was quite successful and an improved model will be built.

(R. C. Zopatti)

7. TX-2

During the past bi-weekly period considerable time has been spent investigating timing problems in the arithmetic element test-control. A satisfactory system of distributing timing levels over long distance on twisted pair leads has been worked out. The pulse distribution system has been decided upon; the necessary co-axial cable assemblies received; and the frame modifications completed. Much information has been gained from the test control, and the last 9-bit quarter of the arithmetic element is now multiplying.

The input-output equipment rack has been installed in the computer room, and the equipment mounted.

Plug-in-unit testing has been continuing. About 125 flip-flops and 50 inverter units have been tested.

7. TX-2 (cont.)

Design work is being done on a new flip-flop using all Philco L-5134 micro-alloy transistors.

A solenoid driver for the IBM electric typewriter, and new clutch and brake control circuits for the photo-electric tape reader are being developed.

Driving circuits for the TX-2 toggle switch storage are also being designed.
(J. Fadiman)

8. Display

The long awaited Tonotypotron for the remote display has finally arrived via a devious route and has been installed in a temporary display cart. Preliminary tests indicate that no special harm has come to the tube during the shipment.

At present the tube has been operated without magnetic deflection. Electrostatic deflection sensitivities for the character selection and compensation plates have been established; and gains of the amplifiers for these plates are now being readjusted to handle the range of swings. The memory circuits of the tubes have been tested but will require more careful adjustment to determine the full capabilities of the memory. The magnetic deflection system had been fixed up at one time, but the effect of the stray fields from the yoke so adversely affected the flood gun beam that no further tests have been possible with the yoke until the stray fields are properly shielded.

For more detailed testing of the tube, tape recordings of typical DDT messages from WWI have been made and are now being played back through an Ampex 400 into the DDR in the remote display rack. The system appears to work quite well with one exception. In the recording of the tapes, a blank message occurred between each data message. Since a console address circuit had not been incorporated in the present rack, the blank messages came through and gave a fixed track message display. The console address circuit has therefore been designed and is being wired into the remote display rack to eliminate this problem. (H. E. Zieman)

9. Personnel

New Personnel - - New staff members in Group 63 include the following people: James Pugsley and Michael Cantella (SA) who are working in Dick Best's section, Peter Barck is in Don Eckl's section, Leopold Neumann and Robert Savell are new to Ben Gurley's section. Allan H. Anderson is a staff associate in Jack Mitchell's section and Anton S. Richert is working in Don Smith's Physics section. At Building 10 Paul Kalaghan is a new staff member.

Terminations - - Mrs. Genevieve Kazdin, who has been the Bldg. 10 Secretary for Group 63, terminated on June 28, 1957. (M. Keene)