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DIGITAL SOLID STATE FUNCTIONAL BLOCKS

A market and product survey of integrated logical elements and a report on the Microelectronics Conference in Munich (October, 1964)

INDEX

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1. Introduction

In our laboratories there is a growing interest in the use of the so-called integrated circuits, micro-miniature elements or whatever name is used.

When we got interested in these elements last year a list was drawn up of manufacturers and their products as well as of the characteristics of these products.

Gradually these lists grew into the form presented here; they were recently brought up to date and checked with the aid of ref. 1, and at the Microelectronics Conference in Munich.

The name "Solid State Functional Blocs" is a generic term which has been adopted by the American Bureau of Standards. One can argue about the merits of this expression, but such a term is certainly needed considering the variety of trade names.

The S.F.Bs are split into two categories : digital and linear. This report is entirely devoted to the digital category, D.S.F.B. for short.

While, for other than technical reasons, we shall not be able to use SFBs immediately, it was thought that at this stage the present survey could be of interest to other potential users in CERN. The author does not claim that this list is 100% complete.

The documentation he assembled during this market survey may be consulted at the office of the RF Group secretary.

2. Report on the Microelectronics Conference

2.1 Present state of the art

Near the end of the '50s smaller discrete components and the transistors allowed miniaturization of electronic instruments.

This process gradually entered the stage of micro-miniaturization but it was realised that this could not go on as the components grew too small to handle.

The development of integration technique presented a major break-through. Not only does this technique allow the manufacturer to decrease the size of the circuit, it also increases its reliability. Moreover the circuits can be produced at a cost much lower than that of all active and passive components used for the same function.

As far as the cost is concerned, the break-even point of the prices for a J.K. flip-flop made of discrete (not miniature) components and a I.I. flip-flop S.F.B. is expected early in 1965 (U.S.A. market, ref. 5, Dr. H.G. Rudenberg).

The reliability shows the following trend :

Failure rates in %/10^3 hrs.

1960	1964	1964	1970 (expected)
Tube FF	Transis.FF	SFB FF	SFB FF
51.57?	5.87	0.08	0,04

These failure rates were further illustrated in a lecture by Dr. H.C. Jone ("Minuteman" reliability project) who quoted the following values :

Firm name	SBF failure rates in % per 1000 hrs	Confidence level
Westinghouse	0.044	60 %
Texas Instruments	0.06	60 %
Fairchild	0.0065	90 %
Signetics	0.009	70 %

This speaker expected that a few years from now monolithic SFBs will have failure rates similar to the ones of the discrete transistors.

As an anecdote it may be worth mentioning here that, although manufacturers boost the idea of space age electronics where SFBs are concerned, Mr. Worden (Hughes Aircraft) who gave a paper on Syncom Reliability was forced to admit that no SFBs are actually flying in any one of the three communication satellites.

While increased reliability and small size are naturally considered as advantages, there are some disadvantages which have as yet not been overcome. These disadvantages are :

a) Interconnections
b) Heat dissipation
c) Testing
4) Circuit design techniques

Sub a) : Especially the interconnections between groups of SFBs is a difficult problem.

Sub b) : The heat dissipation is still rather large considering the smallness of the actual circuit itself. Therefore the reduced dimensions of the SFBs cannot be fully utilized.

It has been calculated that 1 cubic inch of (non-encapsulated) SFBs with the maximum packing density would dissipate about 1 kW.

Many laboratories are engaged in low-level logic research (best results so far : Westinghouse).

Only when the solution to this problem has been found will the discrepancy between the sizes of a power supply and a group of SFBs diminish.

Sub c) : Even where possible, packing density has not been utilized; circuit tests and test points only increase the difficulties mentioned under a) .

Sub c) (contd.) : Unless one adopts the philosophy of throwing away the units which malfunction, one has to increase the complexity by designing a test programme integrated in the unit or by further decreasing the packing density. The latter solution is usually adopted.

Sub d) : The circuit designer has to change his idea about circuits just growing under one's hands. He will have to do much more theoretical work as he will not be able to do as many measurements on the circuit as before.

Modifications to a constructed circuit will be very difficult to carry out - if at all. Firms like Motorola and Fairchild run courses of one or two weeks' duration on Integrated Circuit Design (Motorola $ 450.00 per week).

SFB technology is proceeding along two lines of approach, thin-film and monolithic Si or Ge. Both have certain merits, but the thin-film technology, although superior as far as the construction of resistances and capacitors is concerned, is severely handicapped as no thin-film transistor is produced yet which could reliably be manufactured in series.

All thin-film SFBs on the market now are hybrids which means that they make use of the active components from the other technology.

Data on reliability etc. of hybrid SFBs could not be obtained.

2.2 Future developments

Many research establishments are engaged in tackling the problem of the thin-film transistor.

A S.C.A.T. (surface controlled avalanche transistor) in thin-film technique was reported to exist. Dr. Robertson and Dr. Muller from R.C.A. have reported on a M.O.S. transistor with $f_{\alpha_{co}}$ of well over 1 kMc .

Both the SCAT and the MOS transistor will not be marketed as such but will be integrated only in thin-film SFBs.

It may be assumed that a few years from now these techniques will have advanced sufficiently for thin-film SFBs to be available with upper frequency limits approaching those of our fastest transistors nowadays.

On the other hand the thin film technique will make L.L.L. blocks feasable.

In the near future the package of SFBs and the supply voltage will become normalized.

The flat package will be adopted and the flattened T.O. 5 and T.O. 47 will disappear. Depending on the type of SFB, the flat packs will have one of the following dimensions (only the thickness changes) :

0.375 x 0.285 x 0.065
0.375 x 0.285 x 0.09
0.375 x 0.285 x 0.11 (inches)

The supply voltage will be 3 Volts for most SFBs .

Another trend will be this : more and more designs will make use of the and/or type of logic and the importance of the nand/nor logic, so universally adopted nowadays, will diminish.

European firms, like Philips, Telefunken, etc. are heavily engaged in SFB research, but they do not think to be able to market within the next 2 - 3 years .

Intermetall, through its connection with Shockley Laboratories and Diever Electronics in America, may be in a somewhat better position.

In the United States the situation at some of the major SBF manufacturers is as follows :

<u>Westinghouse</u> has in the laboratory stage a new series of SBFs in D.T.L. configuration. Delays per function are less than 6 nsecs.

<u>Texas Instruments</u> are working on V.H.F. semiconductor functional blocks in the T.T.L. configuration. Typical delays are about 4 nsecs per function. They are of the T.T.C.L. non-saturated switching design and are envisaged for a clock frequency of some 50 Mc/s.

R.C.A. are not marketing at the moment but hope to market, within a few years, thin-film M.O.S. solid state function blocks.

Sylvania will, in a few years' time, market their line of 50 Mc/s AFBs (ref. 7).

The situation at Fairchild, Molectro and Signetics was reported to be similar.

The principal suppliers of SFBs to the American Government during the last years have been : Texas Instruments, Fairchild, Signetics, Molectro and Westinghouse. Runners-up were reported to be Motorola and Sylvania.

An indication of preference could not be obtained.

3. Market Survey

The results of the market survey are given in tabulated form, as is the custom.

Table 3.1 gives the manufacturers' names, their addresses and the names and addresses of their European agents. Column no 1 indicates their key number which is used throughout the following tables.

The next set of tables gives the product survey. The significance of the columns is as follows :

Manufacturer's number as in table 3.1.

Configuration is the key to the circuit design, their abbreviations are given in the abbreviations list.

Clock is the upper frequency limit.

The temperature is denoted by A for 0-125^{o}C and by B for -55 to +125^{o}C.

Prices are quoted in U.S. dollars unless otherwise stated.

Availability is denoted by Roman cyphers for the weeks, or by an "S" for stock.

Package is given by "V" for TO 5 or "F" for flat-pack. Packaging in T.O. 47 is neglected.

Table 3.3 is self-explanatory, the manufacturer and his products are listed and some observations added.

Table 3.3 and the product survey tables do not entirely complement each other, as especially the European firms did not send me their dates in a form that allowed tabulating them in a list.

3.2 Product Survey

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (Key)	Delay (nsec)	0-level (mV)	1-level (mV)	Price $ avail. (key)	Package (key)
					Adders						
11	MWU 908	DCTL	2	10	3	A	90	100	900	19.50 S	V F
15	134 A	RTL	4	12,5	3	A	25	150	800	19.50 S	V F
29	PL 908	DCTL	2	10	3	B	90	150	900	19.50 S	V F
41	SN729/A	RTL	-	10	3-4		~70	200	800		V F
					Counter Adapters						
11	µL901	DCTL	8	55	3	A	22	150	1000	33.00 S	V F
25	SD 2005	RTL	-	55	3	B	21	560	810	30.00 S	V F
29	PL 901	DCTL	10	55	3	B	26	150	1000	32.00 S	V F
46	WM 203	DTL	5	84	6	B	100			S	V F
					Binary Elements						
10	100	CTL	0.1	150	24	A	100	1 mA	12mA	80.00 S	special
10	250	CTL	0.25	150	24	A	100	1 mA	12mA	90.00 S	"
10	100 LSQ	CTL	0.1	150	24	A	100	1 mA	12mA	55.00 S	"
10	100 SQ	CTL	0.1	150	24	55	100	1 mA	12mA	22.00 S	"
15	SC 1051	DTL	4	6	4	A	30	300	4 V	40.00 IV	V F
25	SD 1004	DTL	20	20	6	B	20	710	5 V	50.00 II	V F
35	SE 124	DTL	10	16	-2.4	B	60	300	3 V	45.00 S	V F
35	CS 704	DTL	10	16	-2.4	B	60	300	3 V	50.00 II	V F
46	WM 213	DTL	10	40	6	B	50	1	1.8	S	V F
					And/Nor Gates						
40	SNG5A/15	TTL	20	20	5	B	10	300	3.5V	-	V F
					Or Gates						
3	G	DCTL	0.06	180 µ	3	-10/80	8 µ	3V	100	-	F
41	54 Ser.	TTL	20	-	3	B		2.5V	-	-	F

Manuf No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (Key)	Delay (nsec)	0-level (mV)	1-level (mV)	Price $ avail.	Package (key)
Half Adders											
11	μL904	DCTL	8	35	3	A	22	150	1000	25.00 S	V F
11	MW μL902	DCTL	2	8	3	A	90	100	900	17.00 S	V F
15	134 H	RTL	4	10	3	A	25	150	800	17.00 S	V F
25	SD2002	RTL	-	45	3	B	17	565	815	22.00 S	V F
26	MC 303	MECL	-	60	10	B	6	-1550	-750	17.00 S	V F
29	PL 904	DCTL	10	45	3	B	22	150	1000	25.00 S	V F
	PL 912	DCTL	2	8	3	B	80	150	900	17.00 S	V F
36	A 11	DLT	10	40	5	B	36	900	4800	36.00 I	
Buffers											
2	B12001	DTL	-	5	4	B	100	1 V	1.7 V	47.00 S	V F
11	μL900	DCTL	8	30	3	A	14.5	150	1000	16.00 S	V F
11	Fairchild make at least three more types of buffers										
14	NC/PC12	-	15	200	4/12	A	8	300	2 V	30.00 S	V F
15	134 B	RTL	4	12.5	3	A	25	150	800	14.00 S	V F
21	G.B.	TRL	5	60	6/12	A	25	200	-	15.00 S	F
25	SD2007	RTL	-	45	3	B		560	815	15.00 S	V F
29	PL 900	DCTL	10	30	3	B	17	150	900	16.00 S	V F
41	SN 535	DCTL	5	22	3/4	B	25	300	1.5 V	20.00 S	F
34	19 B 2	-	10	85	4	B	10	250	2000		V
	20 B 2	-	10	90	4	B	-	250	2000		V
Drivers											
3	D	DCTL	0.06	-	8	10/80	-	-	-	-	-
25	SD1003	DTL	-	20	6	B	35	710	5000	40.00 II	V F
26	MC 304	MECL	-	18	10	B	-	-	-	7.00 S	V F
26	MC 205	DTL	-	50	6	B	55	600	2.5 V	50.00 S	V F
35	SE 150	DTL	-	50	4	B	35	300	3 V	40.00 S	V F
41	517 A	RCTL	0.6	25	6	B	-	2.5V	300	40.00 S	V F
43	8213	DTL	20	-	6	B	15	500	3½ V	105.00 II	F
46	WM 210	DTL	5	30	6	B	35	1	1.8	S	V F

Nand Gates

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (key)	Delay (nsce)	0-level (mV)	1-level (nV)	Price $ avail.	Package (key)
14	NC 301	TTL	5	2	3/6	A	20	300	5000	9.00 S	V F
14	NCP 11	DTL	20	6	3/12	A	8	300	5000	40.00 S	V F
14	PC 15	DTL	20	60	3/12	A	8	300	5000	75.00 S	F
17	101	-	5	140	12	80°C	40	400	7000	-	F
21	G.A.	TRL	5	60	6/12	A	25	200	-	25.00 S	F
32	RC 223	DTL	5	6	4	A	25	200	4000	- III	V F
32	RC 224	DTL	5	6	4	A	25	2o0	4000	- III	V F
35	CS 700	DTL	-	12	4	B	25	300	3000	32.00 II	V F
35	CS 701	DTL	-	12	4	B	25	300	3000	32.00 II	V F
39	UC1001B	DTL	10	30	3/6	B	11	400	4000	S	F
41	SN 344A	DTL	0.5	100	3/6	B	150	100	6V	27.00 S	F
41	SN 441A	DTL	0.5	100	3/6	B	150	100	6V	22.00 S	F
41	SN 5410	TTL	20	-	5	B	15	-	-	-	F
41	SN 5420	TTL	20	-	5	B	15	-	-	-	
43	8214	DTL	20	50	3/6	B	10	500	3500	100.00 S	F
46	MW 201	DTL	15	7	6	B	23	100	1800	S	V F
46	MW 204	DTL	15	7	6	B	23	1.0	1.8	S	V F
	MW 205	DTL	4	84	6	B	200	-	-	S	V

And Gates

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (key)	Delay (nsce)	0-level (mV)	1-level (nV)	Price $ avail.	Package (key)
15	SC1048	DTL	4	6/node	4	A	30	300	4V	12.00 IV	V F
26	MC1111	DTL	-	200	10	B	15			26.00 S	V
	MC 203	DTL	-	-	10	B	-			17.00 S	V F
	MC1112	DTL	-	300	10	B	-			30.00 S	V
	MC1113	DTL	-	400	10	B	-			32.00 S	V
	C1114	DTL	-	100	10	B	-			24.00 S	V
35	SE 105	DTL	-	-	-2,4	B	-	300	3V	15.00 II	V F
37	2003	DTL	15	8	3	B	10	250	2.5V	IV	F
43	8207/10	DTL	20	-	6	B	10	250	3.5V	115.00II	F

Nand/Nor Gates

Manuf. no	Type	Config.	Clock (Mc/s)	Diss. mW (max)	Supply (V)	Temp. (key)	Delay (nsec)	0-level (mV)	1-level (mV)	Price $ avail.	Package (key)
2	G. 12002	DTL	-	1	4	B	100	1000	1700	45.00 S	V F
2	G 12003	DTL	-	1	4	B	100	1000	1700	45.00 S	V F
7	H-MODS	DTL	5	400	12/6	0-55	35	-10V	0	400.00 VI	F
7	S-MODS	DTL	1	400	12/6	10-80	90	8V	0	400.00 VI	F
7	E-MODS	DTL	0.1	400	12/6	0-55	250	-10V	0	400.00 VI	F
7	L-MODS	DTL	0.3	400	12/6	0-55	150	-10V	0	400.00 VI	F
7	M-MODS	DTL	2	400	12/6	0-55	80	-10V	0	400.00 VI	F
11	/uL903	DCTL	8	12	3	A	12	150	1000	14.00 S	V F
11	many more types, impossible to list all, consult Fairchild data sheets										
15	134 G	RTL	4	5	3	A	25	150	800	12.00 S	V F
15	134 D 2	RTL	4	5	3	A	25	150	800	12.00 S	V F
15	SC1046	RTL	4	6/node	4	A	30	300	4000	24.00 IV	V F
15	SC1047	RTL	4	6/node	4	A	30	300	4000	20.00 IV	V F
20	XM3001	TTL	5	10	5	B	10-50	500	5V	60.00 VI	F
20	XM3002	TTL	5	10	5	B	10-50	500	5V	-	F
23	HD 903	DTL	2	80	6	B	35	750	3500	20.00 II	F
23	HD 904	DTL	2	80	6	B	35	750	3500	19.00 II	F
26	MC 206	DTL	-	12	-8	B	30			40.00 S	V F
26	MC 201	DTL	-	6	-8	B	30	600	2500	28.00 S	V F
35	SE 102	DTL	-	6	-2.4	B	25	300	3V	22.00 S	V F
35	SE 115	DTL	-	12	-2.4	B	25	300	3V	30.00 S	V F
36	A 01	DTL	7	7	5	B	18	900	2.5V	14.00 S	V F
36	A 02	DTL	7	7/gate	5	B	18	900	2.5V	18.00 S	V F
36	A 20	DTL	20	7	5	B	-	900	2.5V	22.00 S	V F
36	A 05	DTL	30	15/gate	5	B	12	900	2.5V	21.00 S	V F
40	SNG 4A	TTL	20	15	5	B	9	300	3.5V	-	V F
40	SNG 6A	TTL	20	15	5	B	13	300	3.5V	-	V F
40	SNG 12	TTL	20	15	5	B	13	300	3.5V	-	V F
40	SNG 14	TTL	20	15	5	B	9	300	3.5V	-	V F
40	SNG 16	TTL	20	15	5	B	13	300	3.5V	-	V F
41	SN 533	DTL	5	24	3	B	25	300	1.5V	20.00 S	F
41	SN 533	DTL	5	24	3	B	25	300	1.5V	20.00 S	F
41	SN5400	TTL	20	10	5	B	15	-	-	-	F

41 Since November 1964 Texas Instruments has been marketing 7 new types of Nand/nor gates

Flip-flops

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (key)	Delay (nsec)	0-level (mV)	1-level (mv)	Price $ avail. (key)	Package (key)
3	Z	DCTL	0.06	360 µW	3	-10/80°	8 µs	3000	100	-	F
	U	DCTL	0.06	180 µW	3	-10/80°	8 µs	3000	100	-	F
5	FFM	DTL	20	4	4/12	-35/55°	8	1.5V	3.5V	40.00 V	F
11	F µL92329	DCTL	8	60	3,6	A	25	250	1000	6.00 S	V
	MW µ 913	DCTL	2	15	3	A	100	-100	900	33.00 S	V F
	µL 902	DCTL	8	22	3	A	14	150	1000	17.00 S	V F
	µL 916	DCTL	8	54	3	A	25	150	1000	33.00 S	V F
	DT µL913	DTL	5	20	3/6	A	50	200	4000	36.00 S	V F
14	NC/PC 8	-	25	200	4/12	A	8	300	5V	40.00 S	V F
	PC 13	RCD	25	200	4/12	A	8	300	5V	80.00 S	F
16	1035	-	2½	60	9	B	-	-	4V	50.00 S	V F
17	100	-	2	260	12	80°	40	400	7V	-	F
	200	-	0.5	250	12	80°	150	400	7V	-	F
22	FF	TRL	5	60	6/12	A	25	200		15.00 S	F
	UD	TRL	1	60	6/12	A	25	200		15.00 S	F
25	SD 1032	TTL	20	15	6	B	20	400	3000	60.00 II	V F
	SD 2001	RTL	20	22	3	B	22	560	815	16.00 S	V F
26	MC 302	MECL	-	35	10	B	10	-1,5V	-750	12.00 S	V F
	MC 308	MECL	-	52	10	B	10	-1,5V	-750	20.00 S	V F
	MC 209	DTL	-	16	3	B	50	-	-	55.00 S	V F
29	PL 902	DCTL	10	22	3	B	14	150	1000	17.00 S	V F
	PL 916	DCTL	10	54	3	B	20	150	1000	33.00 S	V F
38	12001	DCTL	15	30	3	B	20	250	2000	40.00 IV	F
39	UC1002B	DTL	10	3	3/6	B		400	4V	S	F
40	SFF 18	SUHL	20	30	5	B	15	300	3.5V	-	V F
	SFF 2 A	SUHL	20	40	5	B	20	300	3.5V	-	V F
	SFF 2 B	SUHL	20	45	5	B	20	300	3.5V	-	V F
41	SN 530	DTL	5	50	3/4	B	-	300	1.5V	25.00 S	F
	SN 5470	TTL	20	-	3	B	-	-	-	-	F
43	8200	DTL	50!	100	3/6	B	10	500	3500	120.00 II	F
46	WM 202	DTL	15	15	6	B	23	1	1.8	S	V F
34	16 B 2	TRL	10	90	4	B	-	250	2000	-	V

Input Gates

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (key)	Delay (nsec)	0-level (mV)	1-level (mV)	Price $	Avail. (key)	Package (key)
15	1050	DTL	4	6/node	4	A	30	300	4	29.00	IV	V F
	134 D	RTL	4	5	3	A	25	150	0.8	19.00	S	V F
	365 D	TTL	10	12/gate	4.5	A	55	300	2.8	37.00	II	V F
	365 G	TTL	10	12/gate	4.5	A	55	300	2.8	30.00	II	F
	153 D	RTL	10	20	3	A	12/node	150	1.2	20.00	II	V F
	543 G	CML	10	10	4.5	A	15	3500	4	20.00	II	F
25	SD 1001	DTL	-	20	6	B	18	710	5	33.00	II	V F
25	Molectro markets 8 more types in TTL and RTL											V F
26	MC 309	MECL	-	49	12	B	6	-1.55V	- 0.75	13.00	S	V F
29	PL 915	DCTL	10	24	3	B	12	150	1	32.00	S	V F
29	Philco market 10 more types in DCTL and TTL											V F
36	B 01	TCL	30	40	4.5	B	10	500	2.5	39.00	I	V F
	B 02	TCL	30	40	4.5	B	10	500	2.5	39.00	I	V F
41	516 A	RCTL	600kc	7	3	B	100	2.5V	300mV	32.00	I	F
46	WS 275	TTL	4	25	5.5	B	60	-	-		S	V F
	WS 276	TTL	4	25	5.5	B	60	-	-		S	V F

Nor Gates

Manuf. No	Type	Config.	Clock (Mc/s)	Diss. (mW)	Supply (V)	Temp. (key)	Delay (nsec)	0-level (mV)	1-level (mV)	Price $	Avail. (key)	Package (key)
3	Mod C	DCTL	0.06	800	3	10/80	4 μ	3V	0.1	-		F
5	4 NOR/D	DTL	15	4	6/12	-35/55	10	1.7V	5	35.00	IV	F
	4 NOR/R	RTL	15	4	6/12	-35/55	10	0.3V	5	30.00	IV	F
14	PC 14	DTL	15	170	-3/12	125	8	0.3V	5	70.00		V F
	PC 10	DTL	15	170	-3/12	125	8	0.3V	5	35.00		F
17	102	-	5	140	12	80	40	400	7			F
21	GG	TRL	5	60	6/12	125	25	200	12	13.00	S	F
29	903	DCTL	10	12	3	B	12	150	1	13.00	S	V F
32	RC 103	DCTL	10	15	3	A	20	150	1		S	V
32	Raytheon market 8 more types in DCTL, 5 and 10 Mc/s											V F
43	8204	DTL	20	100	-3/6	B	10	500	3.5	105.00	II	F
45	WL	DCTL	10	15	15	B	15	-	4		VI	V

Miscellaneous Circuits

Manufact. No	
14	RCD Steering network
26	5 Input or/nor and/nand gate
	3 Input or/nor and/nand gate
	Dual inverter
	Memory diode matrices
	D.C. comparator
35	Dual diode array
40	Set/reset single-phase buffer
41	Dual and/or gate
	5 Input and/or gate
43	20 Mc/s DTL pulse shaper
46	DTL diode clusters
15	Power gates
25	Power gates
26	Power gates
35	Power gates
11	Gate expanders
15	Gate expanders
26	Gate expanders
29	Gate expanders
32	Gate expanders
36	Gate expanders
40	Gate expanders
3	2-40 μs PRF 60 kc flatpack one-shot multivib
21	25 ns PRF 5 Mc T 05 and F one-shot multivib
43	30-1000ns PRF 20 Mc flatpack one-shot multivib
14	PRF 10 Mc/s clock multivib. NC/PC 16 T 05, F
14	PRF 10 Mc/s clock multivib PC - 18 F
21	PRF 5 Mc/s clock multivib DM series F
14	5 Mc/s Schmidt trigger type NC/PC 17 T 05, F
21	5 Mc/s Schmidt trigger type ST F

3.4 List of abbreviations

CDL	Core diode logic
CML	Current-made logic
CTL	Core transistor logic
CTR	Core transistor register
DCTL	Direct coupled transistor logic
DTL	Diode transistor logic
DL	Diode logic
LLL	Low level logic
MECL	Motorola emitter coupled logic
MOS	Metal oxide semi-conductor
RCTL	Resistor-capacitor transistor logic
RTL	Resistor-transistor logic
SCAT	Surface-controlled avalanche transistor
SFB	Solid-state functional block
SLT	Solid logic technology
SUHL	Sylvania Universal High Level
TCL	Transistor coupled logic
TDL	Tunnel diode logic
TFFT	Thin-film field effect transistor
TICL	Texas Instruments current mode logic
TRL	Transistor resistor logic
TTL	Transistor transistor logic
ETL	Emitter coupled logic
FET	Field effect transistor

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Further : Catalogues and Data Sheets of practically all above-mentioned firms and manufacturers.

5. Acknowledgements

A survey like this can hardly be compiled without the cooperation of the many firms and their representatives.

I wish to express my gratitude in particular to Mr. E. Klonjian, emeritus chairman of the Microelectronics Circuit Application Committee of the E.I.A. in America who kindly commented on the tables contained in this paper.

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K. Gase

Distribution : (open)

MPS Scientific and Technical Staff

PS/4824 /mt

6. Appendix

Letter from N.V. Philips' Gloeilampenfabrieken, Electronica Department, of December 10th, 1964:

Dear Mr. Gase,

Dr. de Troye of our Research Laboratory informed me about the interest which you expressed on behalf of CERN in the present and future activities of N.V. Philips with regard to integrated circuits.

As the undersigned is in charge of a new product group which has newly been formed for integrated circuits (on semiconductor, thin film and hyvrid thin film basis) I may take the freedom to inform you about our activities at present and the plans we have for the future.

It is our absolute belief that integrated circuits will take a very important place in the building elements activity over the coming years. From the technical point of view integrated circuits are still in their infancy and we may expect a technical evolution as we have experienced so far on semiconductors. This is the reason that our efforts will not be concentrated on one of the available technologies but on all three. We are namely also of the opinion that for every single application it will be necessary to determine which technology will lend itself best - both technically as well as economically - to the given application.

This approach implies that our activities will be concentrated on customer requirements primarily.

From a commercial point of view it will of course be necessary to offer also a standard range of both digital and linear circuits.

We have at present available a linear semiconductor integrated circuit which has primarily been developped for use in hearing aids. We furthermore develop at present a range of DTL and TTL digital circuits which we hope to have available mid-1965. Apart from these ranges we undertake development of any device or range of devices on customer requirement if such a development is justified.

This however implies a thorough technical and commercial contact with the customers and I would therefore welcome very much if you could let us know either by writing or by personal contact your specific wishes.

Hoping to have been of service to you and awaiting your reaction, I remain

Yours faithfully,

pp N.V. Philips' Gloeilampenfabrieken

A.A. Opstelten