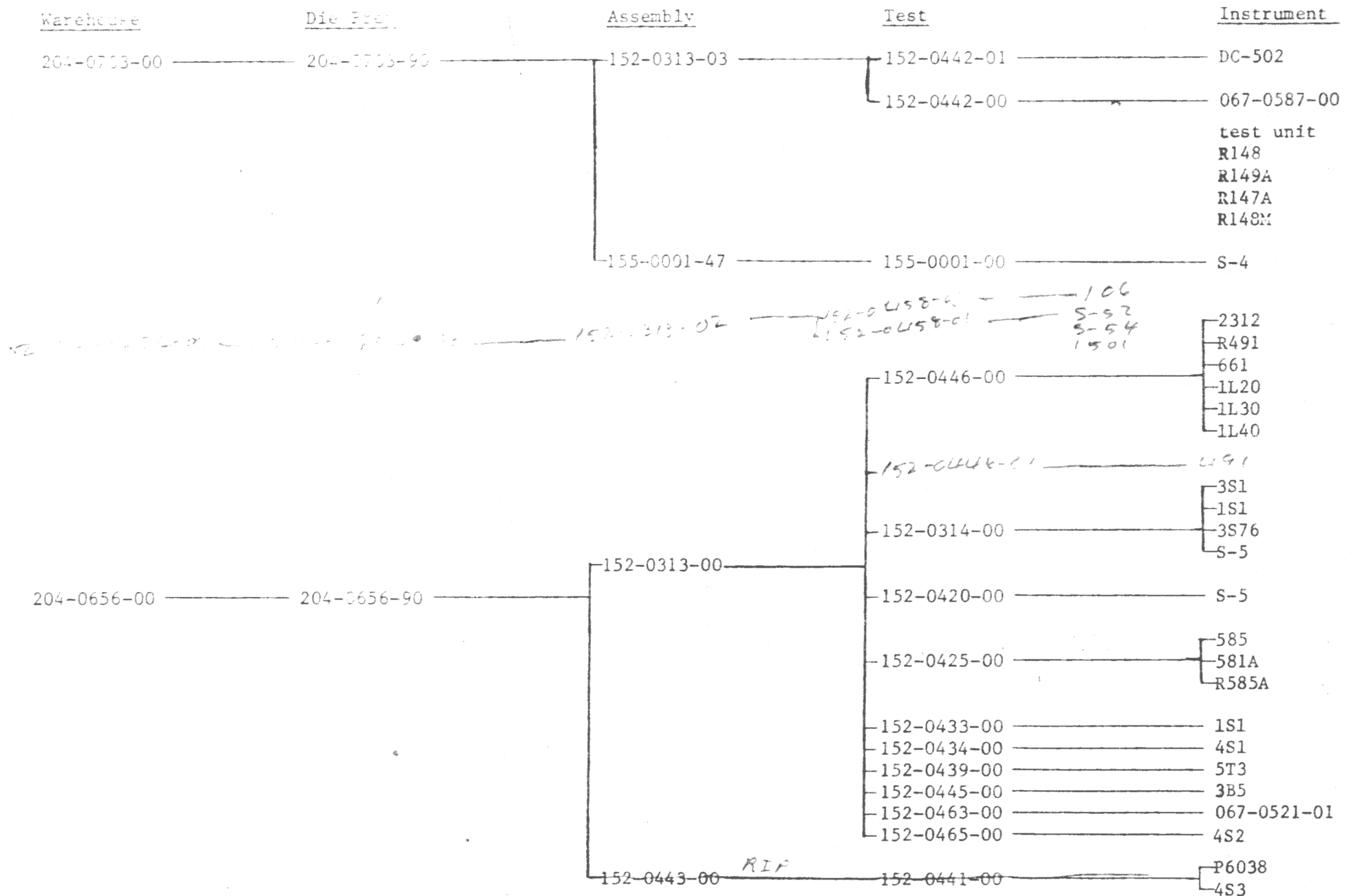
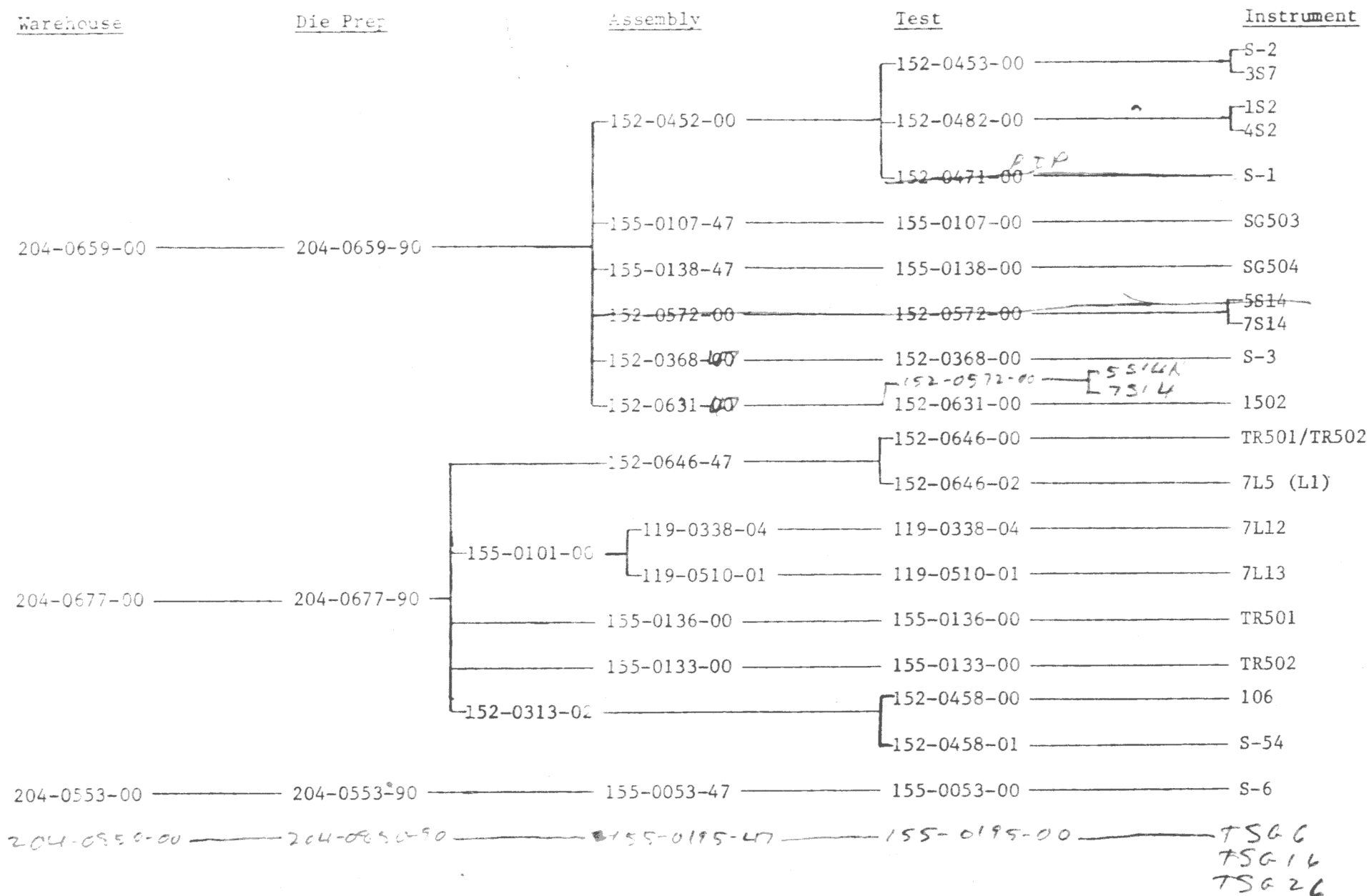


TENTATIVE





TO: Distribution List

DATE: August 22, 1979

FROM:

Handwritten: Paul Lillywhite

SUBJECT: Economic Impact of Tek Made Schottky Diodes

TPM#853

With the cooperation of the various marketing groups, I have determined the economic impact our Schottky diode line has on corporate revenues. (This may be considered an addendum to my memo on "Schottky Diode Status" dated July 12, 1979.) The following table lists current instruments using these diodes, together with selling price and the current estimates of instruments sold per year.

Instrument	#/Year	\$/Instrument	Total \$
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(Lab Instrument Division)

067-0686-00	160	660	\$ 105,600
S-4	150*	1435	215,250
5S14N	25	2470	61,750
7S14	98	2905	284,690
S-3A	130*	965	125,450
S-1	66*	650	42,900
S-5	45*	650	29,250
S-2	321*	780	250,380
S-6	225*	1345	302,625
S-54	32	545	17,440

(IM500)

SG503	1200*	1325	1,590,000
SG504	350*	2295	803,250

(TV Products)

1SG6 1SG16 1SG26	500*	1275	637,500
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(LDT)

1B07	543	3750	2,036,250
491	172	10700	1,840,400
1R501	154	4000	616,000
1R502	42	4900	205,800
715 (11)	454	7250**	3,291,500
712	365	6500	2,372,500
713	537	9500	5,101,500

TOTAL \$19,930,035

- * These instruments are frequently sold as part of a larger system. In many cases, lack of availability of a given instrument could result in loss of a system sale. These systems range from simple oscilloscope calibration systems to complete S-system semiconductor test systems.
- ** The Schottky diodes (152-0646-00) go in the L1 input module. However, we would probably lose a sale for a 7L5 for every L1 not available. Hence this is the combined 7L5/L1 price.

Thus we directly influence about \$20 million in sales, and indirectly an undetermined amount of sales through systems.

Distribution List: Joe Adame
Rich Allen
Dave Cole
Dale DeVries
Steve Das
Len Harris
Arnold Kan
Joe McGrady
John Oatley
Bob Poulin
Jon Schieltz
Martha Siegel
Kris Verma

HL:mm

TO: Distribution List
FROM: *Hal L.*
Hal Lillywhite
SUBJECT: Schottky Diode Status

DATE: July 12, 1979

In the past year and a half, several changes have occurred in our Schottky diode product line. Therefore it appears wise to review this product line with regard to its importance to Tektronix, what changes have and may occur, and what problems exist. Presently, we manufacture 8 different wafer types which go into a total of 31 different packaged parts. These parts support 47 instruments of which 24 are current and 23 customer service. (See attached flow, Appendix A). Without exception, these are low volume products with the greatest expected demand for any single part for Year 000 being 1420 for the 155-0107-00 hybrid peak to peak leveler. Total expected demand for all 31 part numbers is 10886 for Year 000 (of which some are quads and pairs). Thus average demand expected for the year is only 351 parts of each part number (see specification and expected demand summary, Appendix B). These packaged parts may be classified into 3 groups:

1. Parts packaged as single diodes which may be matched in pairs or quads at test (17 part numbers supporting 28 instruments).
2. Parts packaged as pairs or quads in a single package (5 part numbers supporting 6 instruments).
3. Hybrid circuits, some of which in turn are installed in modules (9 part numbers supporting 11 instruments, of which 2 also use parts from group 2).

All 23 customer service instruments are in Group 1. It is apparent that it would be advantageous to consolidate as many part numbers as possible. Some progress has been made in this area already. Three wafer part numbers have been deleted and replaced with other existing part numbers. Another (the 204-0657-00/90) will be as soon as current stock is depleted. Meanwhile, one new part number (the 204-0850-00/90) has been created by using a different back metal scheme on parts otherwise identical to the 204-0703 wafer. Consolidation of other wafer types does not look feasible unless we can obtain a process to eliminate the need for Ni-Cr/Au back metal. Some discussion has occurred along this line, but no concrete plans have emerged yet. If this should occur, we would be able to consolidate the 204-0654 and 204-0703 with other existing wafers.

Another possible route to a more manageable product line is to replace Tek-made parts with diodes manufactured by outside sources. This has already occurred with one use of the 152-0442-01, causing a drastic drop in volume. There is also a mod presently being circulated for approval to replace the 152-0453-00 and 152-0471-00 with outside diodes. Once the replacement diodes are part numbered and in house, I intend to have some tried in several other applications. Gary Sargent also has informed me that Microwave Associates is planning to produce a new diode which, on paper at least, should be able to replace all the parts made from our 204-0656-00 wafer except the 152-0441-00 (which will die a natural death in December of this year anyway). This fiscal year I will attempt to replace as many parts as possible with purchased diodes while continuing to look at possible consolidation of wafers. Wafer types which are candidates for elimination are 204-0703, 204-0654, 204-0656, and 204-0657. Of these, the 204-0657 is virtually certain to be replaced while the others are more tentative. Any wafer types eliminated will of course reduce the wafer and die inventory problems associated with a low volume product line.

There are several problems other than an unwieldy product line. One of these is the packaging of the older types of diodes. The singly packaged diodes which I have classified in Group 1 are packaged by one of 2 methods. One type, the glass diodes, is a solder sealed glass cylinder. The basic process generally works well but is slow compared to modern processes for diode packaging. The real problem is that some of these diodes must then have leads welded to them. The lead welding process has been a source of problems for some time, often due to solder left in the area where the weld must occur. Joe Adame has been asked to look into this problem. This diode type is die attached with a gold-germanium preform. Presently, this requires NiCr/Au back metal which causes us to maintain 2 wafer types which could otherwise be combined with others. The second type of single diode, called the "tab" is even more of a problem. It is also die attached with a Au/Ge preform, this time on a Tek made leadframe. This leadframe requires glass to metal fusing and is a continuing problem in that, as we make it, it is easily broken. The parts are then tested and matched into pairs in fixture test and wrapped around a clothespin-shaped carrier. This last operation is tedious and often results in broken diodes. Furthermore the carriers are plastic and expected to act as springs to hold the diodes in contact with the P.C. board in the instrument. Reliability problems develop as the plastic relaxes. Fortunately, it appears that we will be able to replace all parts using this package with purchased diodes.

Another problem, particularly evident on the 155-0195-00 hybrid sine shaper is the back contact on our diodes. Briefly, we have seen erratic forward characteristics on diodes. This is a particular problem on circuits requiring tight matching as does the above-mentioned circuit. It is not clear at this time if other products are affected. Further information on this problem has been published in interim reports dealing with die attach on the 155-0195-47. (TPM memos #830 and 837 available from Michele Martin, and another memo date April 20, 1979 available from me.)

At least one part specific problem exists, on the 204-0553-00/90 tear tab diode used in the 155-0053-00 sampling gate for the S-6. This diode incorporates a gold tab designed to peel back and become the equivalent of a wire bond. In theory, this should reduce both capacitance and inductance. However, we have had less than spectacular success at getting the tab to survive until we're ready to bond, then peel back as planned without coming off. This diode, in fact, has yet to be made in ICM. An attempt was made to replace it with a purchased beam lead diode, but no such suitable diode was found (see TPM memo #829). Current feeling within ICM management is that the tear tab process should be cleaned up as much as possible and transferred to ICM. I will work with Martha Siegel and Arnold Kan to establish a schedule for this.

There are also a few other processes which do not presently exist in ICM, namely:

- Thin epitaxial layer growth
- Deposition of thicker Ti-W currently used
- Antimony backflash for Sb doped wafers

At one time an agreement was reached for transfer of these processes. However, lack of space has caused these transfers not to happen. We will very likely have to wait until Building 59 is available to process all Schottky's in ICM.

In conclusion, problems with our Schottky diodes are: Packaging, back metal, tear tab processing, and lack of certain processes. Most of these are (or will be) being worked on. The problem of an unwieldy product line has been somewhat alleviated by combining some wafers and by replacing some diodes with purchased parts. These efforts will continue. Although we have a low volume on these parts, Tektronix is committed to the support of the 47 instruments involved until 9 years after they are offered for sale. Therefore, we must either continue to supply the parts involved, or find a suitable replacement and convince the instrument line that the replacement is suitable.

Distribution List:

- Joe Adame
- Rich Allen
- Dave Cole
- Dale DeVries
- Gene Gretchen
- Len Harris
- Arnold Kan
- Joe McGrady
- John Oatley
- Bob Poulin
- Jon Schieltz
- Martha Siegel
- Kris Verma

HL:mn

APPENDIX A

July 9, 1979

<u>Warehouse</u>	<u>Die Prep</u>	<u>Assembly</u>	<u>Test</u>	<u>Instrument</u>
204-0654-00	204-0654-90	152-0313-02	152-0458-00	106
			152-0458-01	S-54 1501
204-0703-00	204-0703-90	152-0313-03	152-0442-01	DC-502 067-0587-01 067-0680-00
			152-0442-00	067-0587-00 test unit
		155-0001-47	155-0001-00	S-4
204-0659-00	204-0659-90	152-0572-47	152-0572-00	5S14 7S14
		152-0368-47	152-0368-00	S-3
		152-0631-47	152-0631-00	1502
		152-0452-01	152-0471-00*	S-1
		155-0107-47	155-0107-00	SG503
		155-0138-47	015-0282-00	SG504

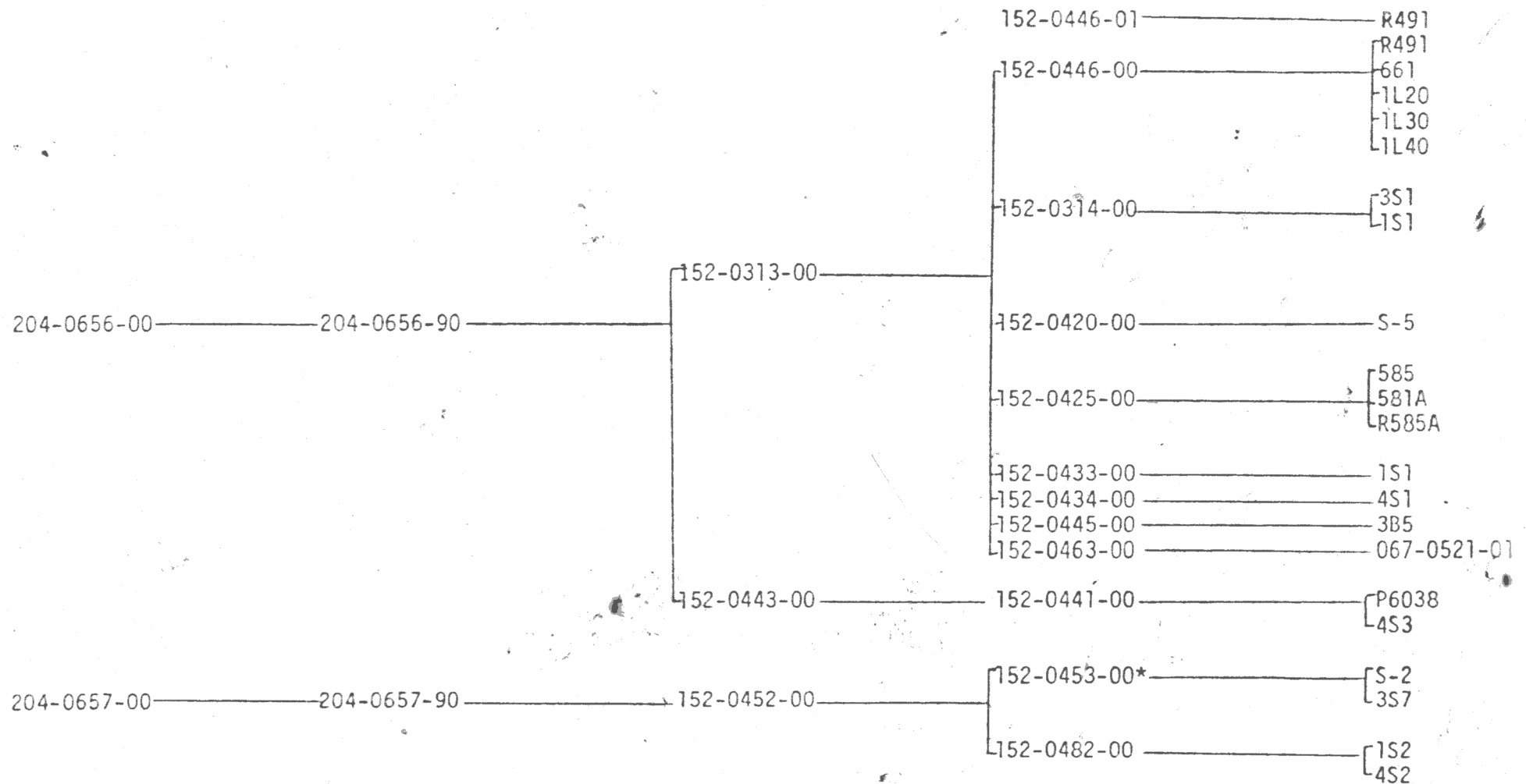
Warehouse

Die Prep

Assembly

Test

Instrument



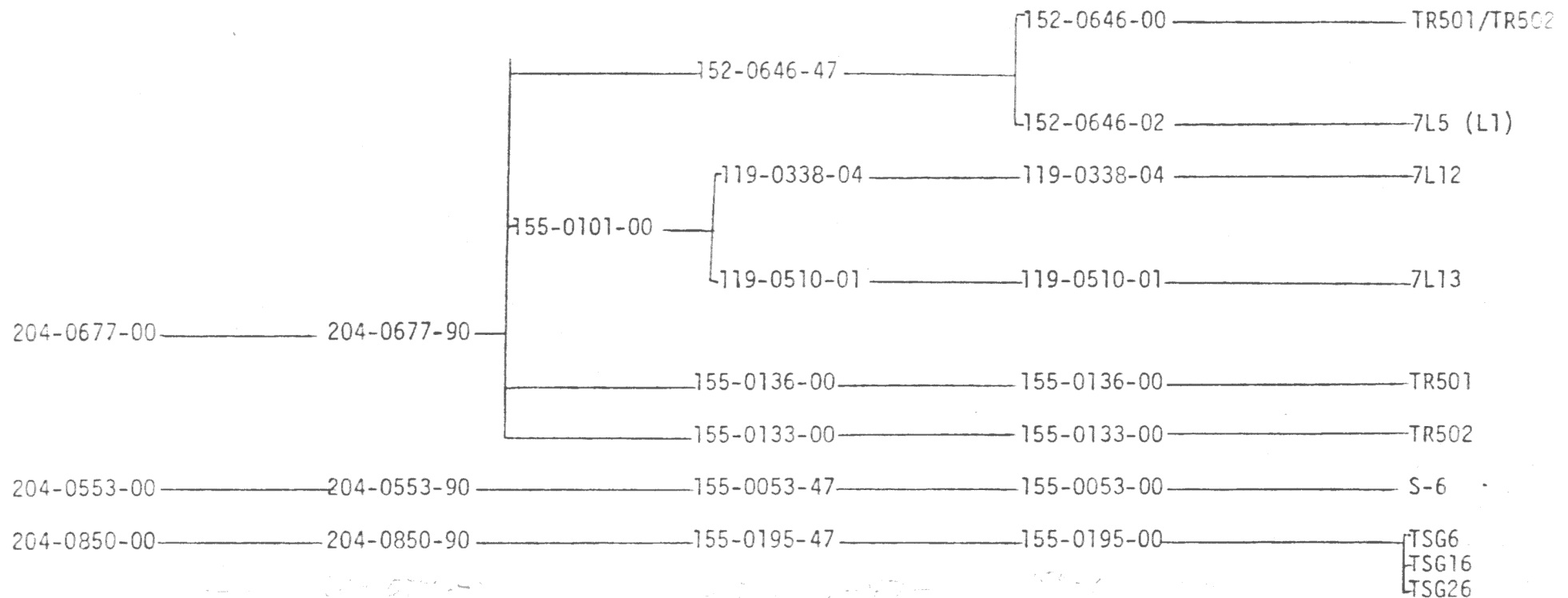
Warehouse

Die Prep

Assembly

Test

Instrument



*Mods in process to replace these parts with purchased diodes.

T7610
T7612

APPENDIX B

SCHOTTKY DIODE SUMMARY

HAL LILLYWHITE

PART NUMBER	PACKAGE TYPE	DIE/ASSY	V_B (1 μ A)	R (10mA)	CAPACITANCE OVDC, 1 MHz	$I_{R, 3V}$ 55°C	MATCHING	EXPECTED DEMAND YR00
152-0314-00	glass	4	$\geq 8V$	$\leq 22\Omega$	$\leq 0.6Pf$	$\leq 30nA$	$\leq 50mV$ (each PR) $\leq 200mV$ (PRtoPR) If = 1-10mA	220
152-0420-00	glass	2	$\geq 5V$	$\leq 30\Omega$	$\leq 0.5 Pf$	$\leq 30nA$	$\Delta R \leq 3\Omega$ at 10mA	760
152-0425-00	glass w/leads	1	$\geq 8V$	$\leq 40\Omega$	$\leq 1.1 Pf$	$\leq 40nA$		115
152-0433-00	glass	4	$\geq 8V$	$\leq 25\Omega$	$\leq 0.6 Pf$	$\leq 30nA$	Each PR: 50mV PR to PR: 200 mV If = 1-10 mA	30
152-0434-00	glass	4	$\geq 8V$	$\leq 20\Omega$	$\leq 0.45 Pf$	$\leq 30nA$	" " " "	210
152-0445-00	glass	1	$\geq 10V$	$\leq 20\Omega$	$\leq 2.0 Pf$	$\leq 10nA$		0
152-0446-00	glass	2	$\geq 8V$	$\leq 25\Omega$ at 20mA	$\leq 0.5 Pf$	$\leq 50nA$	$\Delta R \leq 3\Omega$ at 20mA	335
152-0446-01	glass	1	$\geq 8V$	$\leq 25\Omega$ at 20mA	$\leq 0.5 Pf$	$\leq 50nA$		195
152-0463-00	glass	2	$\geq 8V$	$\leq 30\Omega$	$\leq 0.8 Pf$	$\leq 50nA$ $V_r=2V$	$\Delta V_f \leq 25mV$ at 1-10 mA	70
152-0442-00	glass	2	$\geq 5V$	$\leq 40\Omega$	$\leq 0.3 Pf$	$\leq 30nA$	$\Delta R_f \leq 5\Omega$ at 10mA C 0.04 Pf	300
152-0442-01	glass w/leads	2	$\geq 5V$	$\leq 25\Omega$	$\leq 0.28 Pf$	$\leq 30nA$	$\Delta R_f \leq 5\Omega$ at 10mA	265

152-0458-00	glass	1	$\geq 5V$	$\leq 12\Omega$ (20mA)	$\leq 0.6Pf$	$\leq 60nA$	$\Delta Rf \leq 3\Omega$, 10-20mA	630
152-0458-01	glass w/leads	1	$\geq 5V$	$\leq 12\Omega$ (20mA)	$\leq 0.6Pf$	$\leq 60nA$	$\Delta Rf \leq 3$, 10-20mA	100
152-0441-00	Ceramic	4	$\geq 8V$	$\leq 30\Omega$	≤ 0.5	$\leq 25nA$	Each PR: ≤ 50 mA PR-PR: $\leq 60mV$ 1-10mA	0
152-0453-00	Tab	2	$\geq 7V$	$\leq 75\Omega$	$\leq 0.4Pf$	$\leq 50nA$ @25°C	$\Delta Rf \leq 4\Omega$ or 10% at 10mA $\Delta Vf \leq 50mV$, $\Delta C \leq 0.08Pf$	600
152-0471-00	Tab	2	$\geq 9V$	$\leq 60\Omega$	$\leq 0.4Pf$	$\leq 30nA$ @5V	$\Delta Rf \leq 4$ at 10mA $\Delta C \leq 0.08Pf$	1000
152-0482-00	Tab	2	$\geq 9V$	$\leq 100\Omega$	$\leq 0.30Pf$	$\leq 50nA$ @5V	$\Delta Rf \leq 4\Omega$ at 10mA	30
152-0368-00	glass flat pack	4	$\geq 6V$	$\leq 70\Omega$	$\leq 0.4Pf$	N/A	$\Delta Vf \leq 40mV$ at 10mA	770
152-0572-00	glass flat pack	2	$\geq 4.5V$	$\leq 70\Omega$	$\leq 0.45Pf$	N/A	$\Delta Vf \leq 70mV$ at 10mA	700
152-0631-00	glass flat pack	2	$\geq 9V$	$\leq 70\Omega$	$\leq 0.30Pf$	$\leq 30nA$ @5V	$\Delta Rf \leq 10\%$ at 10mA	1125
152-0646-00	μT	2	$\geq 4V$	$\leq 8\Omega$	$\leq 0.5Pf$ (wafer)	N/A	$\Delta Vf \leq 5mV$ at 1-5mA	470
152-0646-02			$\geq 5V$		11	N/A	$\Delta Vf \leq 5mV$ at 20mA	200
155-0001-00	Hybrid S-4	6	$\geq 5V$	$\leq 25\Omega$	$\leq 0.2Pf$	N/A	$\Delta Rf \leq 3\Omega$	400
155-0053-00	Hybrid S-6	6	$\geq 5V$	$\leq 12\Omega$	$\leq 0.15Pf$	N/A		560

P/N

package

qty

 $V_B (1\mu A)$ $R (10mA)$ Zero bias C
@ 1 MHz $I_R (3V)$
@ 55°C

matching

155-0107-00	Hybrid H204	2	$\geq 14V$ @0.5uA	$\leq 60\Omega$	$\leq 0.30Pf$			1420
015-0282-00	Hybrid H430	4	$\geq 14V$ @0.5uA	$\leq 60\Omega$	$\leq 0.30Pf$			380
155-0209-00	Hybrid H548	2	$\geq 5V$	$\leq 8V$	$\leq 0.8Pf$	N/A	N/A Note: 2 purchased snap-off die also on substrate	Pre-prod

P/N

package
typedie/
assy. V_B $R (10\mu A)$ Zero bias C
@ 1MHz $I_R (3V)$
@ 55°C

Matching.