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HONEYWELL'S CLASS "S" EXPERIENCE



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OFFICE 514 PARTS ENGG.

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WHY CLASS "S" PARTS?

- LONGER MISSIONS FOR SPACE VEHICLES.
- ELECTRONICS ON MOST BOOSTERS ARE NOT REDUNDANT.
- MISSION FAILURE CAN BE CAUSED BY A SINGLE PART FAILURE.
- AF HAS EXPERIENCED SIGNIFICANT FLIGHT AND GROUND FAILURES.
- CONTRACTORS HAVE EXPERIENCED MANY PART FAILURES DURING PART SCREENING AND SYSTEM BUILD AND TEST, RESULTING IN INCREASED COSTS.
- "WHEN A SPACE BOOSTER, CARRYING MULTIPLE SATELLITE PAYLOADS, EXPERIENCES A PART FAILURE, THE RESULTANT LOSS COULD EXCEED \$1 BILLION AND IMPACT NATIONAL SECURITY."

*QUOTE FROM PAPER BY CAPT. D. SETA

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HONEYWELL CLASS "S" EXPERIENCE

- PROPELLANT UTILIZATION CONTROL UNIT (PUCU) ON ATLAS MISSILE (1972 TO 1985)
 - 5 BLOCK BUILDS - 46 FLIGHT UNITS; 31 FLOWN SUCCESSFULLY TO DATE; 15 IN INVENTORY.
 - BLOCKS I TO III - 1972 TO 1978 - USED RESCREENED PARTS.
 - BLOCK IV - 1981 USED LMSC MONITORED LINE PARTS.
 - *BLOCK V - 1981 TO PRESENT - 1ST HI SYSTEM TO USE JAN CLASS "S"

*NOTE: COMPLETED TESTING OF ALL BLOCK V HARDWARE WITH NO GENERIC PARTS PROBLEM. ATP PROBLEMS EXPERIENCED PREVIOUSLY ON OTHER BUILDS - DID NOT MATERIALIZE.

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HONEYWELL CLASS "S" EXPERIENCE (CONTINUED)

- CENTAUR AND SHUTTLE/CENTAUR INERTIAL MEASUREMENT GROUP (1961 TO 1985)
 - CENTAUR HAD SIX BLOCK BUILDS - 95 SYSTEMS BUILT; 70 SUCCESSFUL FLIGHTS TO DATE.
 - EARLY SYSTEMS USED BEST PARTS AVAILABLE - MSFC, MM, JPL AND RESCREENED PARTS.
 - SHUTTLE/CENTAUR IS IN PROCESS OF PROCURING PARTS FOR BLOCK II.
 - BLOCK I - 1983-1984 UTILIZED:
 - 9 CLASS "S" MICROCIRCUITS OUT OF 27 TOTAL TYPES.
 - 5 JAN S SEMICONDUCTORS OUT OF 34 TOTAL TYPES.
 - REMAINING UP-SCREENED PER MIL-STD-975.
 - BLOCK II - 1984 TO PRESENT - NOW AVAILABLE:
 - 23 CLASS "S" MICROCIRCUITS OUT OF 27 TOTAL TYPES.
 - 17 JAN S SEMICONDUCTORS OUT OF 34 TOTAL TYPES.
 - REMAINING RESCREENED PER NEW S/C REQUIREMENTS OR SCD TO JAN S CLASS REQUIREMENTS.

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LEAD TIMES

FOR SHUTTLE/CENTAUR

*THE 9 JAN S MICROCIRCUITS (ALL DIGITAL) PART I QPL
ORDER TO STOCK RANGED 6 TO 40 WEEKS

THE 5 JAN S TRANSISTORS
ORDER TO STOCK RANGED 2 TO 24 WEEKS

JAN CLASS B & JAN TXV UPSCREENED TO MIL-STD-975
ORDER TO STOCK RANGED 25 TO 68 WEEKS

*CAUTION: OEMs SHOULD ALLOW FOR GREATER THAN 52 WEEKS FOR "S"
MICROCIRCUITS ON PART II QPL OR NEW AND SEMICONDUCTORS
THAT ARE NEW TO JAN S.

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HONEYWELL CLASS "S" EXPERIENCE
(CONTINUED)

- SPACE SHUTTLE MAIN ENGINE CONTROLLER (SSMEC)
 - BLOCK II (REDESIGN) IS IN PROCESS OF ORDERING AVAILABLE CLASS "S" MATERIAL.
 - 35 DIFFERENT TYPES OF MICROCIRCUITS.

- DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP)
 - ATTEMPTED TO PROCURE CLASS "S" BUT INSUFFICIENT TIME ALLOWED.

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SUMMARY

JAN CLASS S AND JAN S PARTS USED AT HONEYWELL

MICROCIRCUITS

- 8 TYPES OF TTL
- 26 TYPES OF LSTTL
- 2 TYPES OF STTL
- 1 TYPE OF PROM
- 4 TYPES OF LINEAR
- 2 TYPES OF CMOS

TRANSISTORS

- 6 TYPES

DIODES

- 3 TYPES OF RECTIFIERS
- 1 TYPE GENERAL PURPOSE
- 3 TYPES OF SWITCHING
- 4 TYPES OF ZENER

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DETAIL

JAN CLASS S AND JANS PARTS USED AT HONEYWELL



MICROCIRCUITS

GENERIC NO.

M38510/

5400	00104SCX
5410	00103SCX
5404	00105SCX
5472	00201SCX
5437	00202SCX
5402	00401SCX
54121	01201SCX
54161	01306SEX
54S133	07009SEX
54S74	07101SCX
54LS00	30001SCX
54LS04	30003SCX
54LS10	30005SCX
54LS20	30007SCX
54LS30	30009SCX
54LS73	30101SCX
54LS74	30102SCX
54LS112	30103SEX
54LS174	30106SEX
54LS175	30107SEX
54LS109	30109SEX
54LS40	30201SCX

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DETAIL
 JAN CLASS S AND JANS PARTS USED AT HONEYWELL
 (CONTINUED)



MICROCIRCUITS (CONT'D)

GENERIC NO.

M38510/

54LS02	30301SCX
54LS27	30202SCX
54LS51	30401SCX
54LS32	30501SCX
54LS26	30502SCX
54LS194	30601SEX
54LS164	30605SEX
54LS138	30701SEX
54LS158	30904SEX
54LS251	30905SEX
54LS11	31001SEX
54LS08	31004SCX
54LS14	31301SCX
54LS163	31502SCX
54LS161	31504SEX
54LS193	31508SEX
54LS191	31509SEX
54LS365	32201SEX
54LS367	32203SEX
54LS240	32401SRX
54LS244	32403SRX
54LS273	32501SRX
54LS245	32803SRX

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DETAIL

JAN CLASS S AND JANS PARTS USED AT HONEYWELL
(CONTINUED)

MICROCIRCUITS (CONT'D)

<u>GENERIC NO.</u>	<u>M38510/</u>
825129/54S287	20302SEX
LM101A	10103SGC
LM108A	10104SGC
LM118	10107SGC
LM111	10304SGC
4081B	17001SCX
4069UB	17401SYX

TRANSISTORS

<u>GENERIC NO.</u>	<u>GENERIC NO.</u>
JANS 2N 2219A	JANS 2N 2907A
JANS 2N 2222A	JANS 2N 2920
JANS 2N 2369A	JANS 2N 3501L

DIODES

JANS 1N5550	JANS 1N4454-1
JANS 1N5417	JANS 1N758A-1
JANS 1N5615	JANS 1N759A-1
JANS 1N647-1	JANS 1N967B-1
JANS 1N4150-1	JANS 1N972B-1
JANS 1N4148-1	



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SHUTTLE/CENTAUR SUMMARY - COST JANS MICROCIRCUIT VS JAN B MIL-STD-975 UPGRADE

*These minimums
no longer exist*

A. CLASS "S"

IF PARTS ARE NOT USED FOR ADDITIONAL SYSTEMS - THEN BECAUSE OF MINIMUM BUYS:

AVERAGE COST OF JAN "S" PART IS \$268.92

CLASS "B" UPSCREEN PER MIL-STD-975

AVERAGE COST PER B UPSCREEN PART IS \$296.42

B. IF PARTS WILL BE USED FOR LATER SYSTEM BUILDS - THEN:

CLASS "S"

AVERAGE COST/PART IS \$91.23

CLASS "B" UPSCREEN PER MIL-STD-975

AVERAGE COST/PART IS STILL \$296.42 MAX*

*THE AMORTIZED DRAWING COST COULD BE DEDUCTED.

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DETAIL SHUTTLE/CENTAUR CLASS S MICROCIRCUIT COST

<u>GENERIC</u>	<u>M38510/</u>	<u>COST CLASS S</u>	<u>MIN/BUY QTY</u>	<u>HOLES TO FILL</u>
5410	0013SCX	\$ 5,100	100	8
5472	00201SCX	5,600	100	8
5437	00302SCX	5,100	100	24
5402	00401SCX	5,100	100	8
54161	01306SEX	6,400	100	40
54LS73	30101SCX	8,385	250	48
54LS40	30201SCX	4,150	100	16
54LS174	30107SEX	14,480	250	48
54LS10	30005SCX	1,150	35	24
54LS365	32201SEX	4,250	100	8
54S287/82S129	20302SEX	22,675	100	40
LM101A	10102SGC	55,125	310	248
LM111	10304SGC	10,663	50	48
LM108A	10104SGC	11,025	50	24
		\$159,203	1745	592

AVERAGE TOTAL CLASS "S" COST PER PART FOR HOLES TO FILL - \$159,203/592 = \$268.92.



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DETAIL CLASS B - UPSCREEN PER MIL-STD-975

GENERIC	HOLES TO FILL	*QTY NEEDED CLASS B	RE-BUY DUE TO DPA FAILS	JAN B COST	GROUP B DRAWING & SCREEN COST	TOTAL "B" UPGRADE COST
5410	8	55	2	\$ 377.85	\$ 6,670	\$ 7,047.85
5472	8	55	1	495.00	6,670	7,165.00
5437	24	85	1	691.90	6,670	7,361.90
5402	8	55	0	223.85	6,670	6,893.85
54161	40	115	0	1610.00	6,670	8,280.00
54LS73	48	130	1	790.40	10,240**	11,030.40
54LS40	16	70	1	376.60	7,184	7,570.60
54LS175	48	130	2	1290.90	4,860	6,150.90
54LS10	24	85	0	228.65	6,620	6,848.65
54LS365	8	55	4	852.50	13,140**	13,992.50
54S287/82S129	40	115	1	1449.00	12,618	14,067.00
LM101A	248	504	2	9722.16	13,218**	22,940.16
LM111	48	130	0	2785.90	4,400	7,185.90
LM108A	24	85	0	1678.75	6,045	7,723.75
TOTALS	592	1669		\$24,022.46	\$111,685	\$135,707.46
					PLUS LABOR INTENSE COST	39,775.00
					COST TOTAL FOR B UPGRADE	\$175,482.46

AVERAGE TOTAL "B" UPSCREEN COST PER PART FOR HOLES-TO-FILL - $\$175,482.46/592 = \296.42

*TOTAL QTY=(HOLES TO FILL X BUILD ATTRITION X REC INSP YIELD X SCREEN YIELD) + 2(DPA QTY)
+ (30 DESTRUCT DEVICES (GP B))

**2 SCREENS DUE TO PROBLEMS

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EXCESSIVE NUMBER OF SPECIFICATIONS

HONEYWELL HAS PROCURED THE FOLLOWING GENERIC DEVICES TO DIFFERENT SPECIFICATIONS OR SOURCE CONTROL DRAWINGS (SCD'S) FOR EACH OF THE PROGRAMS INVOLVED IN LAUNCH/OR SPACE ACTIVITY.

PROGRAM	DRAWINGS		
	<u>LM101A</u>	<u>LM108A</u>	<u>LM111</u>
CENTAUR	2	2	2
SHUTTLE/CENTAUR	3	2	2
SPACE SHUTTLE MEC		3	3
DMSP	3	3	3
PUCU		3	4
	8 DRAWINGS	13 DRAWINGS	14 DRAWINGS

35 DRAWINGS FOR THREE DEVICE TYPES.

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LEGEND FOR DRAWING TYPES AVAILABLE

- | | | |
|----|------------------|--|
| A. | JAN M38510/ | STANDARD |
| B. | JAN B UPSCREENED | NASA STD. |
| C. | JAN B SCREENED | AF/SD O.K. WITH WAIVER |
| D. | MONITORED LINE | AF/SD O.K. WITH WAIVER |
| E. | MSFC DWG. | OLD STANDARD |
| F. | "S" PROCESSED | MIL-STD-1547 REQUIREMENT IF JAN S NOT AVAILABLE. |

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WHY THIS PROLIFERATION?

DUE TO UPGRADE OF EACH BLOCK BUILD. ALSO, EACH PROGRAM MUST HAVE CONTROL OF THE DRAWING; THEREFORE, SPECIFICATION PROLIFERATION. IT HAS BEEN SAID THAT ONE VENDOR MAY HAVE FOUND IT NECESSARY TO CREATE GREATER THAN 100,000 PART NUMBERS FOR 600 GENERIC DESIGN DEVICES.

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BASIC STANDARD USED BY AIR FORCE, ARMY AND NASA AGENCIES

USAF/SD <u>MIL-STD-1546/1547</u>	NASA <u>MIL-STD-975</u>	USAF/BMD <u>SAMSO-STD-77-7</u>	ARMY-BMD MILITARY STANDARD
1. 1ST CHOICE: CLASS "S", JAN S QUALIFIED PARTS.	1ST CHOICE: AVAIL-ABLE CLASS "S" QUALIFIED PARTS.	1ST CHOICE: PARTS SPECIFIED IN MINUTE-MAN PREFERRED PARTS LIST FOR APPROVED APPLICATION.	
2. 2ND CHOICE: SUBSTITUTE LMSC MONITORED LINE PART WITH QUALITY CONFORMANCE TESTING REQUIRES PMPCB APPROVAL.	UP-SCREEN QUALIFIED CLASS B OR JTXV PARTS TO 975 REQUIREMENTS.	2ND CHOICE: SCD'S THAT INCORPORATE RADIATION HARDENING TESTS, PROCESS CONTROL, PARAMETER DRIFT TESTS, ETC. - APPROVAL BY THE MM PARTS BOARD.	
3. 3RD CHOICE: CONTRACTOR SCD PER MIL-STD-1547 AND PMPCB APPROVAL (CLASS "S" PROCESSED).			
4. RESCREEN NOT ALLOWED - UNLESS BY WAIVER/ DEVIATION TO CONTRACT.			

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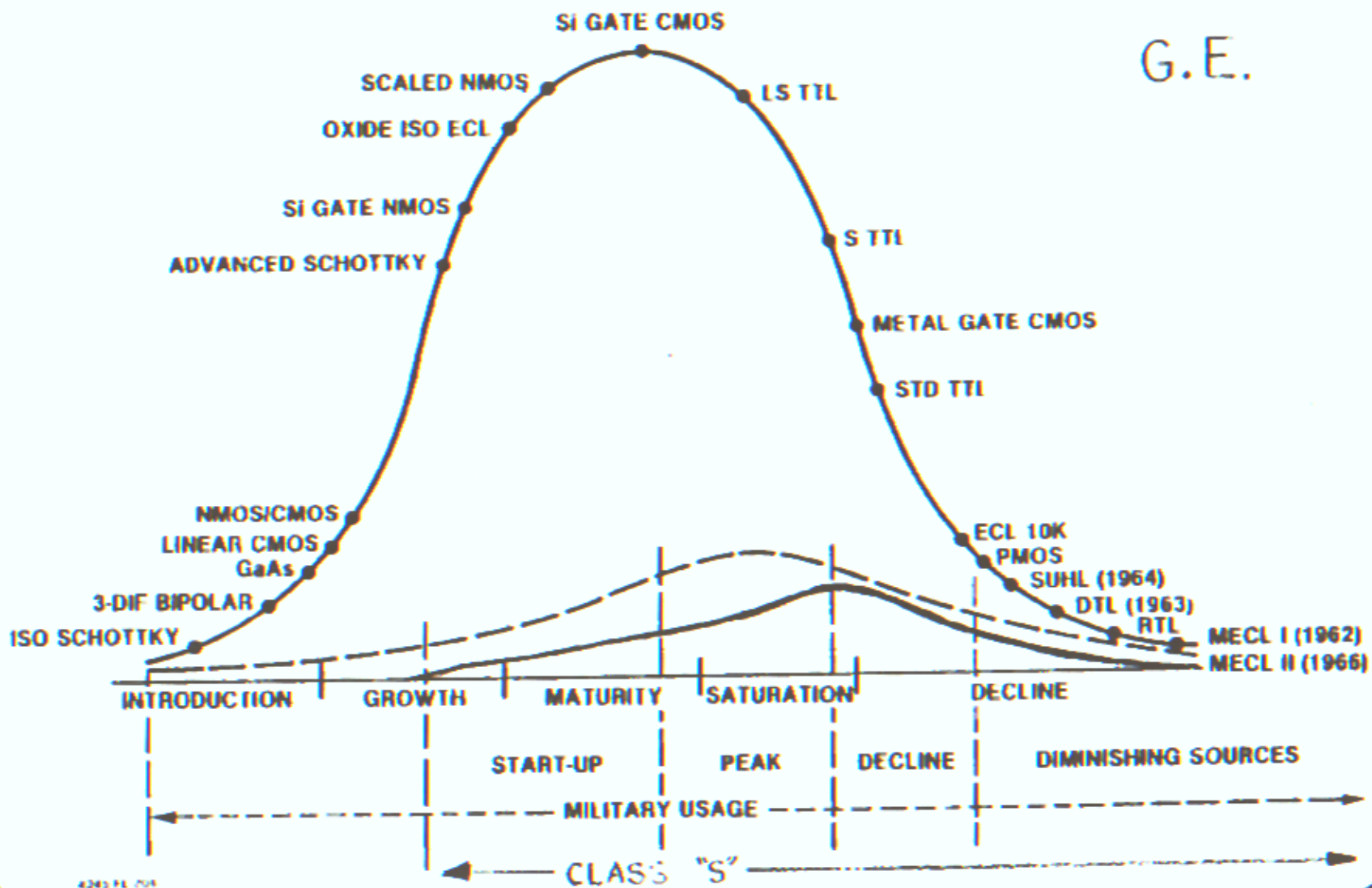


NOT MANY OEM'S USING CLASS S

- HONEYWELL'S EXPERIENCE IN BUYING AND ATTEMPTING TO BUY CLASS "S" PARTS SEEMS TO HAVE UNCOVERED A LACK OF PURSUIT BY OEM'S AND GOV'T AGENCIES WHO FEEL UP FRONT CLASS S COST IS GREATER THAN "B" UPSCREEN/OR SCD.
 - CONTRACTORS WON'T BID IN COST OF S PRODUCTS DUE TO FEAR OF LOSING ON COST BASIS - CLASS "S" PROGRAMS ARE COSTLY UP FRONT.
 - GOVERNMENT NOT SCRUTINIZING BIDS FOR S ADHERENCE.

- ALSO, RELUCTANCE OF MANUFACTURERS TO QPL DUE TO EXCESSIVE LINE CERTIFICATION AND MAINTENANCE COSTS IN RELATION TO BUSINESS VOLUME.
 - JAN S & CLASS S SPECIFICATIONS AND STANDARDS MAY BE EXCESSIVE - NEED TO IDENTIFY COST DRIVERS.

Product Life Cycle Microcircuit Technologies/Families



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THE FUTURE AND CLASS "S"

CLASS S MUST PROVIDE FOR DYNAMIC FORWARD LOOKING METHODS TO DESIGN TODAY FOR TOMORROW'S PRODUCT WITHOUT PROLIFERATING DRAWINGS.

SUGGESTED WAYS

- o USE DESC "CLASS S" DRAWINGS UNTIL THE CLASS "S" DEVICES ARE QUALED.
- o USE VENDOR CLASS "S" PROCESSED DEVICES UNTIL THE CLASS "S" DEVICES ARE QUALED.
- o USE MONITORED LINE SERVICE FOR GETTING NEWER TECHNOLOGY DEVICES QUICKLY UNTIL THE CLASS "S" DEVICES ARE QUALED.

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SUMMARY

- **EXPAND USE OF CLASS "S"**
 - LIFE CYCLE COST IS LESS DUE TO INCREASED RELIABILITY.
 - FRONT END COST IS LESS DUE TO EXCESSIVE COST OF UP-SCREENING.

- **CLEAR ROADBLOCKS TO INCREASED AVAILABILITY OF CLASS "S"**
 - STOP SPEC PROLIFERATION.
 - SERVICES & NASA GET COMMON REQUIREMENTS.
 - SERVICES & NASA REQUIRE CONTRACTORS TO PURSUE CLASS "S".
 - STREAMLINE CLASS "S" REQUIREMENTS.

- **PROVIDE FOR FORWARD LOOKING RAPID METHODS TO UTILIZE NEWER TECHNOLOGIES IN TODAY'S DESIGNS FOR TOMORROW'S PRODUCTS.**

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