

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, SCHOTTKY TTL, MULTIPLE NOR GATES,
 MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic, silicon, Schottky TTL, positive NOR logic gating microcircuits. Two product assurance classes and a choice of case outlines and lead finishes are provided for each type and are reflected in the complete part number.

1.2 Part number. The complete part number shall be in accordance with MIL-M-38510.

1.2.1 Device type. The device type shall be as follows:

<u>Device type</u>	<u>Circuit</u>
01	Quadruple 2-input positive NOR gate

1.2.2 Device class. The device class shall be the product assurance level as defined in MIL-M-38510.

1.2.3 Case outline. The case outline shall be designated as follows:

<u>Outline letter</u>	<u>Case outline (see MIL-M-38510, appendix C)</u>
A	F-1 (14-lead, 1/4" x 1/4"), flat-package
B	F-3 (14-lead, 3/16" x 1/4"), flat package
C	D-1 (14-lead, 1/4" x 3/4"), dual-in-line package
D	F-2 (14-lead, 1/4" x 3/8"), flat-package

1.3 Absolute maximum ratings.

Supply voltage range	-0.5 V dc to 7.0 V dc
Input voltage range	-1.2 V dc at -18 mA to 5.5 V dc
Storage temperature range	-65°C to +150°C
Maximum power dissipation per gate	62 mW dc <u>1/</u>
P_D	+300°C
Lead temperature (soldering, 10 seconds)	
Thermal resistance, junction-to-case (θ_{JC}):	
Cases A, B, and D	70°C/W
Case C	50°C/W
Junction temperature (T_J)	+175°C

1/ Must withstand the added P_D due to short circuit condition (e.g. I_{OS}) at one output for 5 seconds duration.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center (RBE-2), Griffiss AFB, NY 13441, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Recommended operating conditions.

Supply voltage (V_{CC})	- - - - -	4.5 V dc minimum to 5.5 V dc maximum
Minimum high level input voltage (V_{IH})	- - -	2.0 V dc
Maximum low level input voltage (V_{IL})	- - -	0.8 V dc <u>2/</u>
Normalized fanout (each output) <u>3/</u>	- - -	10 maximum
Case operating temperature range (T_C)	- - -	-55°C to +125°C

2. APPLICABLE DOCUMENT

2.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards, of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-M-38510, and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 Terminal connections and logic diagrams. The terminal connections and logic diagrams shall be as specified on figure 1.

3.2.2 Truth tables. The truth tables shall be as specified on figure 2.

3.2.3 Schematic circuits. The schematic circuits shall be submitted to the preparing activity prior to inclusion of a manufacturer's device in this specification and shall be submitted to the qualifying activity as a prerequisite for qualification. All manufacturers' schematics shall be maintained and available upon request.

3.2.4 Case outlines. The case outlines shall be as specified in 1.2.3.

3.3 Lead material and finish. The lead material and finish shall be in accordance with MIL-M-38510 (see 6.5).

3.4 Electrical performance characteristics. The electrical performance characteristics are specified in table I, and apply over the full recommended case operating temperature range, unless otherwise specified.

2/ $V_{IL} = 0.7$ V dc at +125°C.

3/ Device will fanout in both high and low levels to specified number of data inputs on the same device type as that being tested.

TABLE I. Electrical characteristics.

Test	Symbol	Conditions $-55^{\circ}\text{C} \leq T_C \leq +125^{\circ}\text{C}$	Limits		Unit
			Min	Max	
High-level output voltage	V_{OH}	$V_{CC} = 4.5 \text{ V}; V_{IN} = 0.8 \text{ V};$ $I_{OH} = -1 \text{ mA}$ <u>4/</u>	2.5	---	Volts
Low-level output voltage	V_{OL}	$V_{CC} = 4.5 \text{ V}; V_{IN} = 2.0 \text{ V};$ $I_{OL} = 20 \text{ mA}$ <u>1/</u> <u>5/</u>	0.2	0.5	Volts
Input clamp voltage	V_{IC}	$V_{CC} = 4.5 \text{ V}; I_{IN} = -18 \text{ mA}$	---	-1.2	Volts
Collector cut-off current	I_{CEX}	$V_{CC} = 5.5 \text{ V}; V_{IL} = \text{GND}$ $V_{IH} = 5.5 \text{ V}$	---	250	μA
High-level input current	I_{IH1}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 2.7 \text{ V}$	---	50	μA
	I_{IH2}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 5.5 \text{ V}$	---	1.0	mA
Low-level input current	I_{IL}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 0.5 \text{ V}$ <u>2/</u>	-1	-2.0	mA
Short-circuit output current	I_{OS}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 0 \text{ V}$ <u>3/</u>	-40	-100	mA
High-level supply current, <u>per gate</u>	I_{CCH}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 0 \text{ V}$	---	29	mA
Low-level supply current, <u>per gate</u>	I_{CCL}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 5.5 \text{ V}$	---	45	mA
Propagation delay time, high-to-low level	t_{PHL}	$C_L = 50 \text{ pF}; R_L = 280 \Omega;$ $V_{CC} = 5.0 \text{ V}$	2.0	9.0	ns
Propagation delay time, low-to-high level	t_{PLH}	$C_L = 50 \text{ pF}; R_L = 280 \Omega;$ $V_{CC} = 5.0 \text{ V}$	2.0	9.0	ns

1/ All unspecified inputs grounded.

2/ All unspecified inputs at 5.5 V.

3/ Not more than one output should be shorted at a time.

4/ $V_{IN} = 0.7 \text{ V}$ at $+125^{\circ}\text{C}$.

5/ $V_{OL} = 0.45 \text{ V}$ at $+125^{\circ}\text{C}$.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (see table III)	
	Class S devices	Class B devices
Interim electrical parameters (pre burn-in) (method 5004)	1	1
Final electrical test parameters (method 5004)	1*,2,3, 9,10,11	1*,2,3, 9
Group A test requirements (method 5005)	1,2,3, 9,10,11	1,2,3, 9
Group B test requirements (method 5005) subgroup 5	1,2,3, 9,10,11	N/A
Group C end-point electrical parameters (method 5005)	N/A	1,2,3
Additional electrical subgroups for group C periodic inspections	N/A	10,11
Group D end-point electrical parameters (method 5005)	1,2,3	1,2,3

*PDA applies to subgroup 1 (see 4.2c).

3.5 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.6 Marking. Marking shall be in accordance with MIL-M-38510. At the option of the manufacturer, marking of the country of origin may be omitted from the body of the microcircuit, but shall be retained on the initial container.

3.7 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 8 (see MIL-M-38510, appendix E).

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-M-38510 and methods 5005 and 5007 of MIL-STD-883, as applicable, except as modified herein.

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- a. Burn-in test (method 1015 of MIL-STD-883).
 - (1) Test condition D or E, using the circuit shown on figure 3, or equivalent.
 - (2) $T_A = +125^\circ\text{C}$ minimum.

- b. Interim and final electrical test parameters shall be as specified in table II, except interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.
- c. The percent defective allowable (PDA) for class S devices shall be as specified in MIL-M-38510. The PDA for class B devices shall be 10 percent based on failures from group A, subgroup 1 tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883, and with no intervening electrical measurements. If interim electrical tests are performed prior to burn-in, failures resulting from pre burn-in screening may be excluded from the PDA. If interim electrical tests prior to burn-in are omitted, then all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent defective for that lot, and the lot shall be accepted or rejected based on the PDA for the applicable device class.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table I of method 5005 of MIL-STD-883 and as follows:

- a. Test shall be as specified in table II herein.
- b. Subgroups 4, 5, 6, 7, and 8 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883. Electrical parameters shall be as specified in table II herein.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table III of method 5005 of MIL-STD-883 and as follows:

- a. End-point electrical parameters shall be as specified in table II herein.
- b. Subgroups 3 and 4 shall be added to the group C inspection requirements for class B devices and shall consist of the tests, conditions, and limits specified for subgroups 10 and 11 of group A.
- c. Steady-state life test (method 1005 of MIL-STD-883) conditions, or equivalent.
 - (1) Test condition D or E, using the circuit shown on figure 3, or equivalent.
 - (2) $T_A = +125^\circ\text{C}$ minimum.
 - (3) Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510 and method 1005 of MIL-STD-883.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table IV of method 5005 of MIL-STD-883. End-point electrical parameters shall be as specified in table II herein.

4.5 Methods of inspection. Methods of inspection shall be specified as follows:

4.5.1 Voltage and current. All voltages given are referenced to the microcircuit ground terminal. Currents given are conventional and positive when flowing into the referenced terminal.

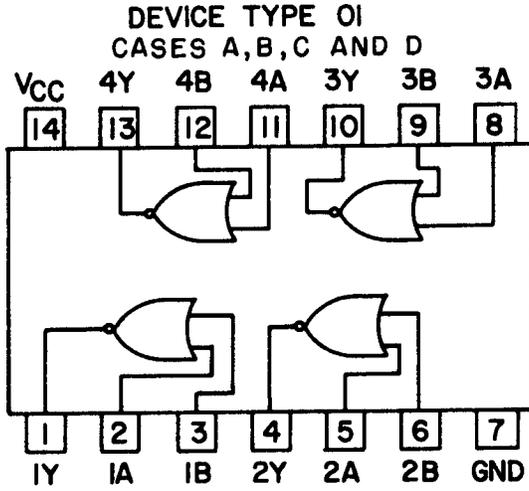
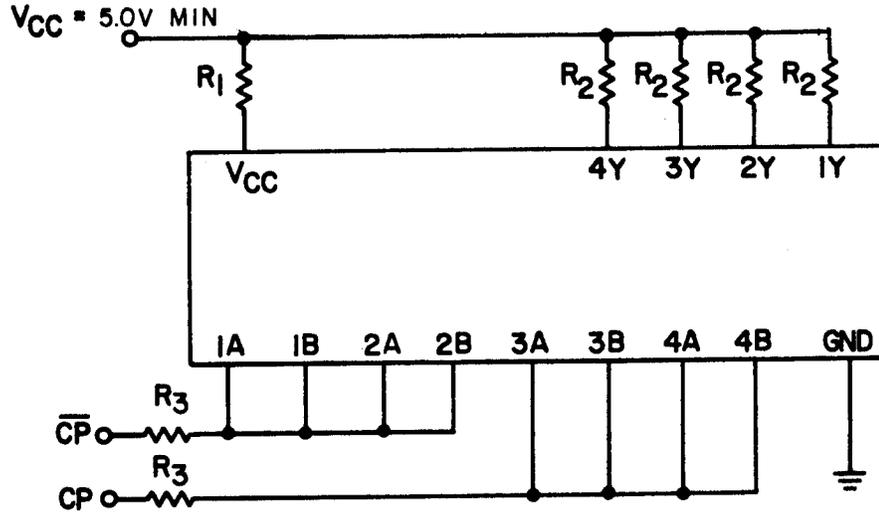


FIGURE 1. Logic diagram and terminal connections (top view).

Truth table each gate		
Input		Output
A	B	Y
H	X	L
X	H	L
L	L	H

X = Irrelevant
Positive logic: $Y = \overline{A+B}$

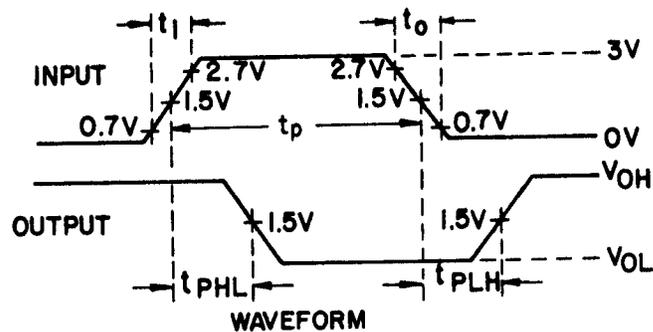
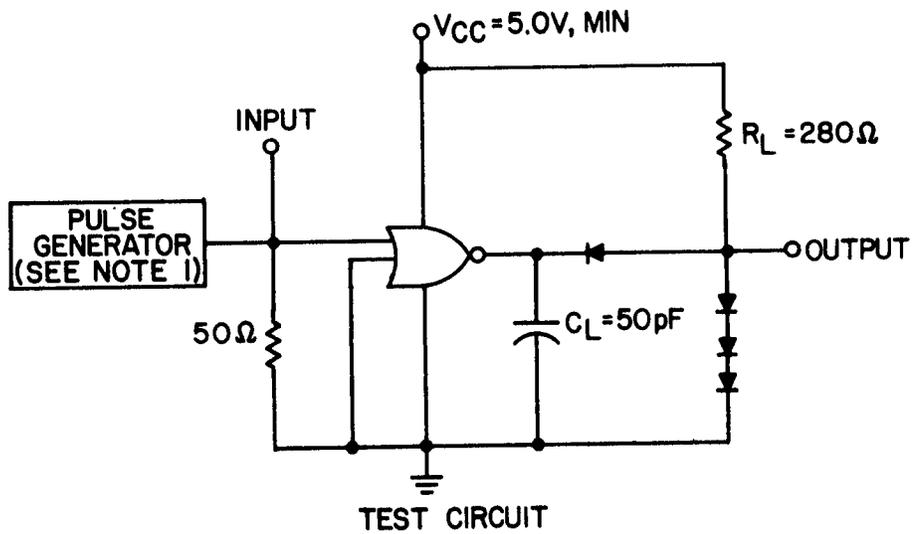
FIGURE 2. Truth tables and logic equation.



NOTES:

1. $R_1 = 26.1\Omega \pm 1\%$.
2. $R_2 = 121\Omega$ to 240Ω .
3. $R_3 = 26.1\Omega \pm 5\%$.
4. CP or \overline{CP} = 100 kHz 50% square wave; duty cycle = $50 \pm 15\%$;
 $V_{IL} = -0.5$ V min to 0.8 V max; $V_{IH} = 2.0$ V min to 5.5 V max.

FIGURE 3. Burn-in and life test circuit.



NOTES:

1. Pulse generator has following characteristics: $t_1 = t_0 < 2.5 \text{ ns}$, $t_p = 200 \text{ ns}$, and $Z_{out} \approx 50 \Omega$.
2. $C_L = 50 \text{ pF}$ minimum, including scope probe, wiring, and stray capacitance, without package in test fixture.
3. Voltage measurements are to be made with respect to network ground terminal.
4. All diodes are 1N3064, or equivalent.

FIGURE 4. Switching time test circuit and waveforms.

TABLE III. Group A inspection for device type 01.
Terminal conditions (pins not designated may be high ≥ 2.0 V or low ≤ 0.8 V, or open).

Subgroup	Symbol	MIL-STD-1883 method	Cases A, B, C, D	Terminal conditions														Limits						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	Measured terminal	Min	Max	Unit			
1 $T_C = +25^\circ\text{C}$	V_{OH}	3006	1 2 3 4	1Y	1A	1B	2Y	2A	2B	GND	3A	3B	3Y	4A	4B	4Y	VCC	1Y	2.5	V dc				
				-1 mA	0.8 V 5.5 V	0.8 V 5.5 V	-1 mA	5.5 V 0.8 V 5.5 V	5.5 V 0.8 V 5.5 V	GND	5.5 V 0.8 V 5.5 V	5.5 V 0.8 V 5.5 V	GND	5.5 V 0.8 V 5.5 V	5.5 V 0.8 V 5.5 V	-1 mA	4Y	4.5 V						
				20 mA 20 mA	2.0 V GND	2.0 V GND	20 mA 20 mA	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	20 mA 20 mA	2Y 3Y 4Y						
	V_{OL}	3007	5 6 7 8 9 10 11 12	20 mA 20 mA	2.0 V GND	2.0 V GND	20 mA 20 mA	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND	2.0 V GND		1Y	0.2	0.5	V		
																				1Y				
																					2Y			
																					3Y			
																					3Y			
																					3Y			
																					4Y			
																					4Y			
V_{IC}		13 14 15 16 17 18 19 20	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA	-18 mA		1A	-1.2	V				
																			1B					
																				2A				
																				2B				
																					3A			
																					3B			
																					4A			
																					4B			
I_{IH1}	3010	21 22 23 24 25 26 27 28	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND	2.7 V GND		1A	50	μA				
																			1B					
																				2A				
																				2B				
																					3A			
																					3B			
																					4A			
																					4B			
I_{IH2}		29 30 31 32 33 34 35 36	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND	5.5 V GND		1A	1.0	mA				
																			1B					
																				2A				
																				2B				
																					3A			
																					3B			
																					4A			
																					4B			
I_{IL}	3009	37 38 39 40 41 42 43 44	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V	0.5 V 5.5 V		1A	-1	-2	V			
																			1B					
																				2A				
																				2B				
																					3A			
																					3B			
																					4A			
																					4B			
I_{IOS}	3011	45 46 47 48	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1Y	-40	-100	V			
																			2Y					
																				3Y				
																				4Y				

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.3 Ordering data. The acquisition document should specify the following:

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirements for certificate of compliance, if applicable.
- d. Requirements for notification of change of product or process to the contracting activity in addition to notification to the qualifying activity, if applicable.
- e. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action, and reporting of results, if applicable.
- f. Requirements for product assurance options.
- g. Requirements for special carriers, lead lengths, or lead forming, if applicable. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- h. Requirements for "JAN" marking.

6.4 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-M-38510, MIL-STD-1331, and as follows:

GND	- - - - -	Ground zero voltage potential
I _{IN}	- - - - -	Current flowing into an input terminal
V _{IN}	- - - - -	Voltage level at an input terminal

6.5 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class B (see 1.2.2) and lead material and finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.6 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information shall not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-M-38510.

<u>Military device type</u>	<u>Generic-industry type</u>
01	54S02

6.7 Manufacturers' designation. Manufacturers' circuits which form a part of this specification are designated with an "X" as shown in table IV herein.

TABLE IV. Manufacturers' designation.

Device type	Manufacturer			
	Circuit A	Circuit B	Circuit C	Circuit E
	TEXAS INSTRUMENTS	SIGNETICS	NATIONAL	FAIRCHILD
01	X	X	X	X

6.8 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to extensiveness of the changes.

Custodians:
 Army - ER
 Navy - EC
 Air Force - 17

Preparing activity:
 Air Force 17
 (Project 5962-0616)

Review activities:
 Army - AR, MI
 Navy - SH, OS
 Air Force - 11, 19, 85, 99
 DLA - ES

User activities:
 Army - SM
 Navy - AS, CG, MC

Agent:
 DLA - ES