MOTOROLA

2N918 (SILICON)

ALSO AVAILABLE AS JAN AND HI-REL UNITS

NPN silicon annular transistors with high reliability designed for use in VHF and UHF amplifier, mixer and oscillator applications.

Active elements isolated from case

CASE 20
(TO-72)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Base Voltage	V_{CB}	30	Vdc
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Emitter-Base Voltage	V_{EB}	3.0	Vdc
Collector Current	I_C	50	mAdc
Total Device Dissipation @ T_C = 25°C	P_D	300	mW
Derating Factor Above 25°C		1.71	mW/°C
Total Device Dissipation @ T_A = 25°C	P_D	200	mW
Derating Factor Above 25°C		1.14	mW/°C
Operating & Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200	°C

TABLE I : GROUP A INSPECTION (T_A = 25°C ± 3°C unless otherwise noted)

Examination or Test		Mil-Std-750 Method	Symbol	Limits Min	Limits Max	Unit	*LTPD
SUBGROUP 1							
Visual and Mechanical Examination		2071	-	-	-	-	10
SUBGROUP 2							
Collector-Base Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	All Types	3036 Condition D	I_{CBO}	-	10	nAdc	5
Collector-Base Breakdown Voltage (I_C = 1.0 μAdc, I_E = 0)	All Types	3001 Condition D	BV_{CBO}	30	-	Vdc	
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	All Types	3026 Condition D	BV_{EBO}	3.0	-	Vdc	
Collector-Emitter Breakdown Voltage (I_C = 3.0 mAdc, I_B = 0)	All Types	3011 Condition D	BV_{CEO}	15	-	Vdc	
DC Current Gain (V_{CE} = 10 Vdc, I_C = 10 mAdc)	JAN2N918	3076	h_{FE}	20	-	-	
(V_{CE} = 1.0 Vdc, I_C = 3.0 mAdc)	JAN2N918‡			20‡	200		
(V_{CE} = 10 Vdc, I_C = 500 μAdc)	JAN2N918			10	-		
Base-Emitter Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)	All Types	3066 Condition A	V_{BE}	-	1.0	Vdc	
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)	All Types	3071	$V_{CE(sat)}$	-	0.4	Vdc	

*Applies to Meg-A-Life II and Mil Units Only
‡Minimum value only applies to Standard Unit

2N918, JAN 2N918 (continued)

TABLE I : GROUP A INSPECTION (T_A = 25°C ± 3°C unless otherwise noted) (continued)

Examination or Test		Mil-Std-750 Method	Symbol	Limits Min	Limits Max	Unit	*LTPD
SUBGROUP 3							
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f ≥ 0.1 MHz & ≤ 1.0 MHz)	All Types	3236	C_{ob}	-	1.7	pF	
(V_{CB} = 0, I_E = 0, f ≥ 0.1 MHz & ≤ 1.0 MHz)	All Types			-	3.0		
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f ≥ 0.1 MHz & ≤ 1.0 MHz)	All Types	3240 (Note 1)	C_{ib}	-	2.0	pF	
SUBGROUP 4							
Small-Signal Current Gain (V_{CE} = 10 Vdc, I_C = 4.0 mAdc, f = 100 MHz)	All Types	3306	$\|h_{fe}\|$	6.0	-	-	
Small-Signal Amplifier Gain (V_{CC} = 12 Vdc, I_C = 6.0 mAdc, f = 200 MHz)	All Types	(Figure 2)	G_{pe}	15	-	dB	
Collector-Base Time Constant (V_{CB} = 10 Vdc, I_E = -4.0 mAdc, f = 79.8 MHz)	JAN2N918		$r_b'C_c$	-	25	ps	10
Noise Figure (V_{CE} = 6.0 Vdc, I_C = 1.0 mAdc, R_G = 400 ohms, f = 60 MHz)	All Types	(Note 2)	NF	-	6.0	dB	
Oscillator Power Output (V_{CB} = 15 Vdc, I_C = 8.0 mAdc, f = 500 MHz)	All Types	(Note 3)	P_{out}	30	-	mW	
Collector-Efficiency Test (V_{CB} = 15 Vdc, I_C = 8.0 mAdc, f = 500 MHz)	All Types	(Note 3)	η	25	-	%	
SUBGROUP 5 (Note 4)		(Note 4)					
High Temperature Operation							
Collector-Base Cutoff Current (V_{CB} = 15 Vdc, I_E = 0, T_A = 150°C)	All Types	3036 Condition D	I_{CBO}	-	1.0	μAdc	
Low Temperature Operation							
DC Current Gain (V_{CE} = 1.0 Vdc, I_C = 3.0 mAdc, T_A = -55°C)	JAN2N918	3076 (Note 4)	h_{FE}	10	-	-	

*Applies to Meg-A-Life II and Mil Units Only

NOTES:

1. This test shall be in accordance with Method 3240 of MIL-STD-750 except that the output capacitor is omitted.
2. Noise Figure shall be measured using a HP 342A NF Meter in accordance with HP 342A pertinent test procedure or by use of a suitable equivalent test-equipment circuit and procedure.
3. Sample units shall be allowed to return to and be stabilized at room ambient temperature prior to being subjected to the Low-Temperature Operation test.
4. Test Measurement shall be made after thermal equilibrium has been reached at the temperature specified.
5. All applicable end-point test measurements shall be made within four hours after the particular sample units have been subjected to the required physical-mechanical or environmental test(s). This requirement is not applicable to measurements specified to be made during (subjection of sample units) a physical-mechanical or environmental test, and shall not be applicable where otherwise specified for life test(s).
6. There shall be no evidence of flaking, pitting, or other visible signs of corrosion on sample units, upon examination without magnifications, after subjection to test.
7. Per MIL-STD-202, Method 112, Test Condition C, Procedure 111a and Test Condition A for Gross Leaks.

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TABLE II : GROUP B INSPECTION

(Fourth lead is "floating" unless otherwise specified.)

Examination or Test	Mil-Std-750 Method	Symbol	Limits Min	Limits Max	Unit	LTPD
SUBGROUP 1						
Physical Dimensions	2066	-	-	-	-	20
SUBGROUP 2						
Solderability	2026	-	-	-	-	10
Temperature Cycling	1051 Condition C	-	-	-	-	
Thermal Shock (Glass Strain)	1056 Condition A	-	-	-	-	
Seal (Leak Rate)	(Note 7)					
Moisture Resistance (No Initial Conditioning)	1021	-	-	-	-	
End-Point Tests: (Note 5)						
Collector-Base Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	3036 Condition D	I_{CBO}	-	10	nAdc	
DC Current Gain (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc)	3076	h_{FE}	20	200	-	
SUBGROUP 3						
Shock (1500 G, 0.5 ms, 5 blows each, Orientations X_1, Y_1, Y_2, Z_1; Total = 20 blows)	2016 Non-operating	-	-	-	-	10
Vibration, Variable Frequency	2056	-	-	-	-	
Vibration Fatigue (20 G)	2046 Non-operating	-	-	-	-	
Constant Acceleration (Centrifuge) (20,000 G, Orientations X_1, Y_1, Y_2, Z_1)	2006	-	-	-	-	
End-Point Tests:						
Same as Subgroup 2 (Note 5)						
SUBGROUP 4						
Lead Fatigue	2036 Condition E	-	-	-	-	15
End-Point Tests:						
Seal (Notes 5 and 7)			-	$5x10^{-7}$	atm cm^3/s	
SUBGROUP 5						
Salt Atmosphere (Corrosion) (Note 6)	1041	-	-	-	-	20
End-Point Tests:						
Same as Subgroup 2						
SUBGROUP 6						
High Temperature Life (Non-Operating) (T_{stg} = +200°C, min)	1031 Non-operating	-	-	-	-	λ = 15
End-Point Tests: (Note 5)						
Collector-Base Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	3036 Condition D	I_{CBO}	-	20	nAdc	
DC Current Gain (I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc)	3076	h_{FE}		± 25% of Group A Limits	-	
SUBGROUP 7						
Steady State Operation Life (P_T = 200 mW, I_C = 20 mAdc, T_A = 25°C ± 3°C)	1026	-	-	-	-	λ = 15
End-Point Tests: (Note 5)						
Same as Subgroup 6						

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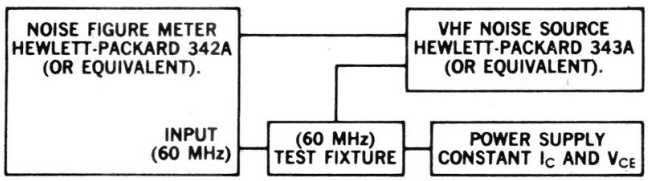
TABLE III: CONDITIONING and SCREENING

Procedure	Symbol	Mil-Std-750 Method	Conditions	Limits
BURN-IN at rated Power for 96 hours	–	–	V_{CE} = 10 Vdc, T_A = 25°C	–
ELECTRICAL SCREENS After Burn-In				
DC Current Gain	Δh_{FE}	3076	I_C = 3.0 mAdc, V_{CE} = 1.0 Vdc, Pulsed*	±20% Within Group A Limits
Changes in h_{FE} before and after Burn-In, measured at stated conditions.				
Collector-Base Cutoff Current	I_{CBO}	3036 Condition D	V_{CB} = 15 Vdc	Group A Limits
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	3071	I_C = 10 mA, I_B = 1.0 mA; Pulsed*	
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	3066 Condition A	I_C = 10 mA, I_B = 1.0 mA; Pulsed*	

* Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%

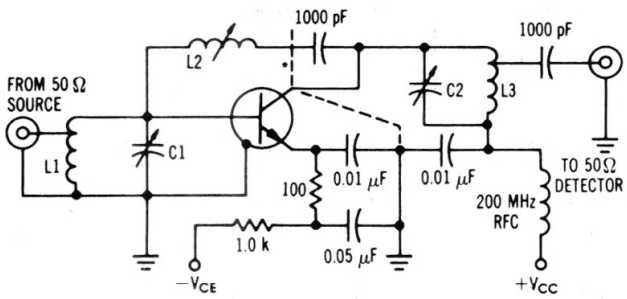
FIGURE 1 — NOISE FIGURE TEST BLOCK DIAGRAM



The test fixture shall consist of a 60 MHz tuned amplifier and suitable biasing circuits. It should be constructed utilizing good very-high-frequency design techniques.

The effective source susceptance should be tuned for each device being tested to obtain minimum noise figure. Note that because the HP 343A has a 50-ohm output resistance, a suitable impedance transformer must be used to obtain an effective source conductance of 2.5 mmho at the transistor with minimum losses.

FIGURE 2 — NEUTRALIZED 200 MHz POWER AMPLIFIER GAIN TEST CIRCUIT



NEUTRALIZATION PROCEDURE:

A — Connect 200 MHz signal generator (with 50 ohm output impedance) to input terminals of amplifier, and connect 50 ohm RF voltmeter to output terminals of amplifier.

B — Apply V_{EE} and V_{CC} to obtain specified test conditions.

C — Adjust output of signal generator to approximately 10 millivolts and tune C1 and C2 for maximum output.

D — Interchange connections to signal generator and RF voltmeter and with sufficient signal applied at output terminals, tune L2 for minimum indication on RF-voltmeter.

E — Repeat this sequence until optimum settings are obtained for all variables.

CIRCUIT COMPONENT INFORMATION:

C1: 3-12 pF

C2: 1.5-7.5 pF

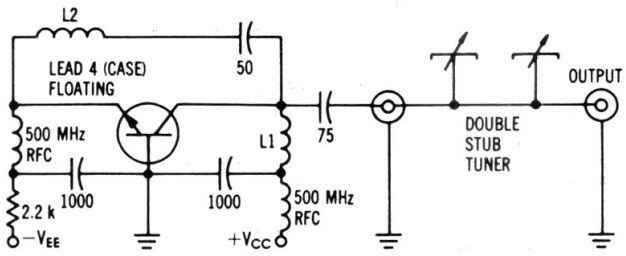
L1: 3 1/2 turns #16 AWG 5/16" ID, 7/16" length, turns ratio — 2 to 1

L2: 0.4-0.65 μH Miller #4303 (or equal)

L3: 8 turns #16 AWG 1/8" ID, 7/8" length, turns ratio — 8 to 1

*External interlead shield to isolate collector lead from emitter and base leads.

FIGURE 3 — 500 MHz OSCILLATOR TEST CIRCUIT



OSCILLATOR ADJUSTMENT PROCEDURE:

Measurements of P_{out} shall be made in this circuit or a suitable equivalent. The circuit adjustment procedure is as follows:

A — Set V_{CC} and V_{EE} to obtain specified test conditions.

B — Adjust stub tuner to obtain maximum output at specified frequency of oscillation.

C — Check I_C and reset if necessary.

D — Read P_{out}.

Note: Collector efficiency (η), may be determined as follows:

$$\eta \text{ in } \% = \frac{P_{out}}{120} \times 100$$

Where P_{out} is in milliwatts.

CIRCUIT COMPONENT INFORMATION:

L1: 2 turns #16 AWG, 3/8" OD, 1 1/4" length

L2: 9 turns #22 AWG, 3/16" OD, 1/2" length

Capacitance values are in pF.

Double Stub Tuner consists of the following commercially available components.

2 GR Type 874 TEE
1 GR Type 874-D20 Adjustable Stub
1 GR Type 874-LA Adjustable Line
1 GR Type 874-WN3 Short-Circuit Termination

(or equivalents)