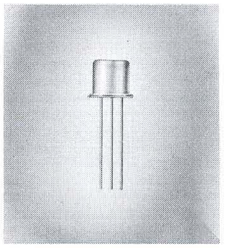
N-P-N DOUBLE-DIFFUSED MESA SILICON TRANSISTOR

TYPE 2N715
BULLETIN NO. DL-S 1188, JANUARY 1960

VHF Oscillator-Amplifier Transistor

- **Operation to 200 mc**
- **Guaranteed rf power output**
- **High breakdown voltage**



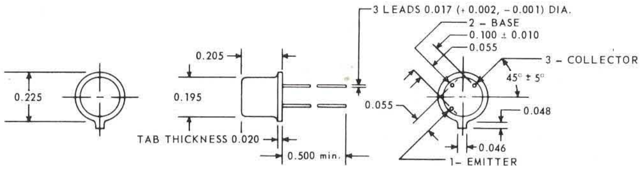
environmental tests

All units are heat cycled from —65°C to +175°C for 10 cycles. The hermetic seal is checked by pressure testing. All units are completely tested for electrical characteristics and undergo a rigorous tumble test to check for mechanical reliability.

mechanical data

Welded case with glass-to-metal hermetic seal between case and leads. Unit weight is approximately 1/3 gram. These units meet JEDEC TO-18 case outline dimensions.

THE COLLECTOR IS IN ELECTRICAL CONTACT WITH THE CASE



DIMENSIONS ARE MAXIMUM IN INCHES UNLESS OTHERWISE SPECIFIED

maximum ratings at 25°C ambient (unless otherwise noted)

Collector-Base Voltage	50 v
Collector-Emitter Voltage (See note 1)	35 v
Emitter-Base Voltage	5 v
Total Device Dissipation (See note 2)	0.5 w
Total Device Dissipation at 25°C Case Temperature (See note 3)	1.2 w
Storage Temperature Range	—65°C to +175°C

electrical characteristics at 25°C ambient (unless otherwise noted)

PARAMETER		TEST CONDITIONS	min	typ	max	unit
I_{CBO}	Collector Reverse Current	$V_{CB} = 30$ v, $I_E = 0$	—	—	1.0	μa
I_{CBO}	Collector Reverse Current	$V_{CB} = 30$ v, $I_E = 0$, $T_A = +150°C$	—	—	100	μa
I_{CBO}	Collector Reverse Current	$V_{CB} = 50$ v, $I_E = 0$	—	—	10	μa
I_{EBO}	Emitter Reverse Current	$V_{EB} = 5$ v, $I_C = 0$	—	—	100	μa
BV_{CEO}*	Collector-Emitter Breakdown Voltage	$I_{CEO} = 20$ ma, $I_B = 0$	35	—	—	v
h_{FE}*	D-C Forward-Current Transfer Ratio	$V_{CE} = 10$ v, $I_C = 15$ ma	10	—	50	—
$V_{CE(sat)}$*	Collector-Emitter Saturation Voltage	$I_C = 15$ ma, $I_B = 3$ ma	—	—	1.2	v
C_{ob}	Output Capacitance	$V_{CB} = 5$ v, $I_E = 0$, f = 1 mc	—	3	6	μμf
r_{ies}	Short-Circuit Common-Emitter Series Input Resistance	$V_{CE} = 10$ v, $I_E = -15$ ma, f = 70 mc	—	65	—	ohms
r_{oep}	Short-Circuit Common-Emitter Parallel Output Resistance	$V_{CE} = 10$ v, $I_E = -15$ ma, f = 70 mc	—	1.5	—	k ohms
f_T	Frequency at which $\lvert h_{fe} \rvert = 1$	$V_{CE} = 10$ v, $I_E = -15$ ma	70	150	—	mc

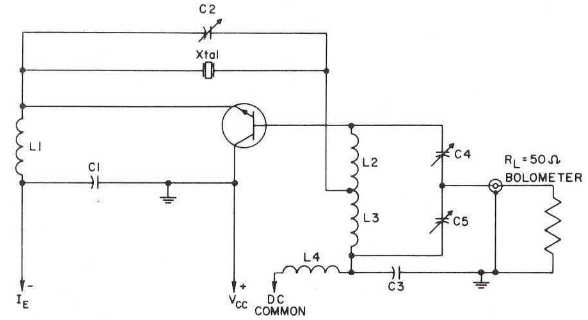
functional tests at 25°C ambient (see circuits on last page)

OPERATING CHARACTERISTICS	TEST CONDITIONS	min	typ	max	unit
Oscillator Output Power	$V_{CB} = 30$ v, $I_C = 25$ ma, f = 70 mc	200	250	—	mw
Amplifier Power Output	$V_{CB} = 30$ v, $I_C = 25$ ma, $P_{in}(ac) = 120$ mw, f = 70 mc	300	400	—	mw
Transducer Gain	$V_{CB} = 30$ v, $I_C = 25$ ma, $P_o(ac) = 300$ mw, f = 70 mc	4	8	—	db

*Semiautomatic testing is facilitated by using pulse techniques to measure these parameters. A 300-microsecond pulse (approximately 2% duty cycle) is utilized. Thus, the unit can be tested under maximum current conditions without a significant increase in junction temperature. The parameter values obtained in this manner are particularly pertinent for switching circuit design and, in general, indicate the true capabilities of the device.

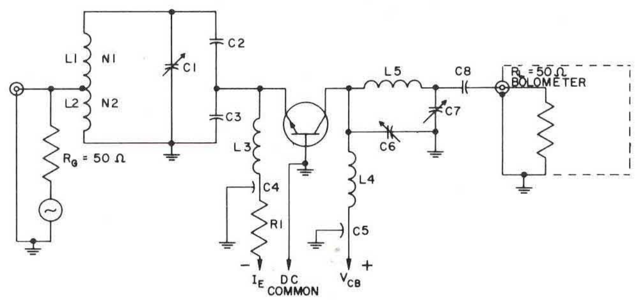
TEST CIRCUITS

OSCILLATOR TEST CIRCUIT



Symbol	Description		Manufacturer	Part No.
C1 & C3	0.01 μfd		Mucon	Type RLA
C2	3-35 μμfd		Arco	403
C4	9-180 μμfd		Arco	463
C5	6-140 μμfd		Hammarlund	HF-140
L1	0.84 μh		Ohmite	Z-235
L2	0.101 μh	2 turns No. 14 wire, center tapped	Air Dux	1206S
L3	0.107 μh			
L4	1.8 μh		Ohmite	Z-144
Xtal	70 mc Crystal		International	F-605

AMPLIFIER TEST CIRCUIT



Symbol	Description		Manufacturer	Part No.
C1	2.7-30 μμfd		Arco	461
C2	6.8 μμfd		Centralab	TCZ-6.8
C3	15 μμfd		Centralab	TCZ-15
C4 & C5	2300 μμfd		Centralab	FT-2300
C6	9-180 μμfd		Arco	463
C7	65-320 μμfd		Arco	303-M
C8	0.1 μfd		Centralab	
L1	0.25 μh	4½ turns No. 18 wire random wound $\frac{N1}{N2} = 4$	CTC ceramic coil form	LS7
L2	0.08 μh			
L3 & L4	1.8 μh		Ohmite	Z-144
L5	0.25 μh	6½ turns No. 18 wire random wound	CTC ceramic coil form	LS5
R1	2000 ohm		IRC	

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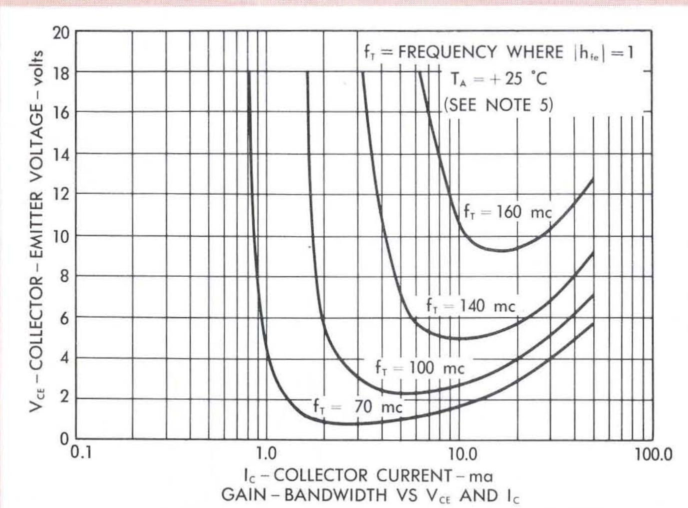
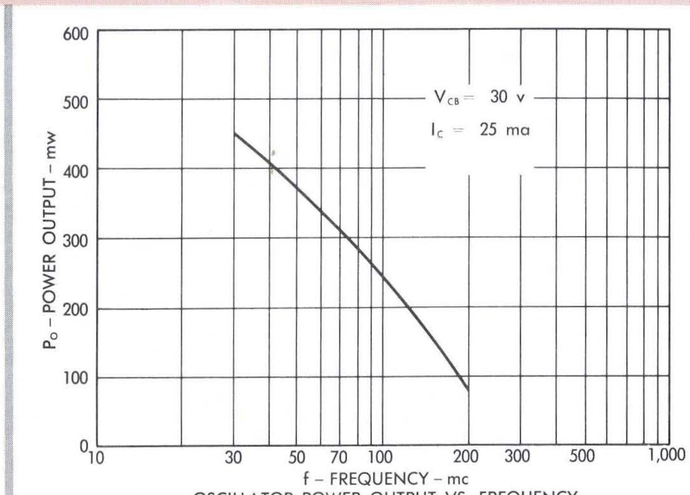
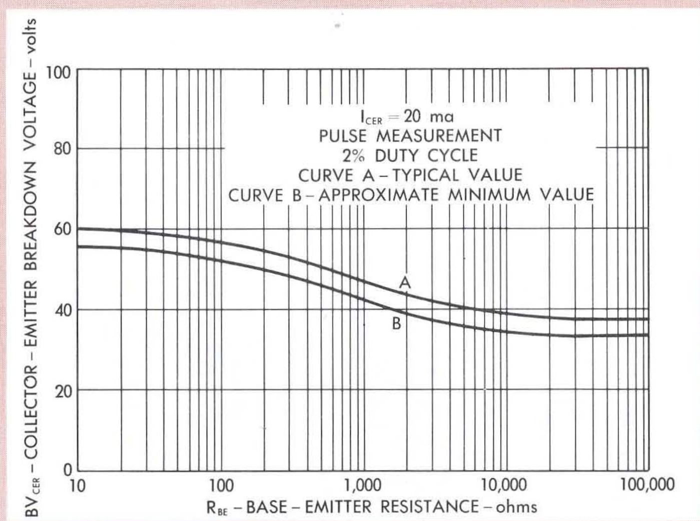


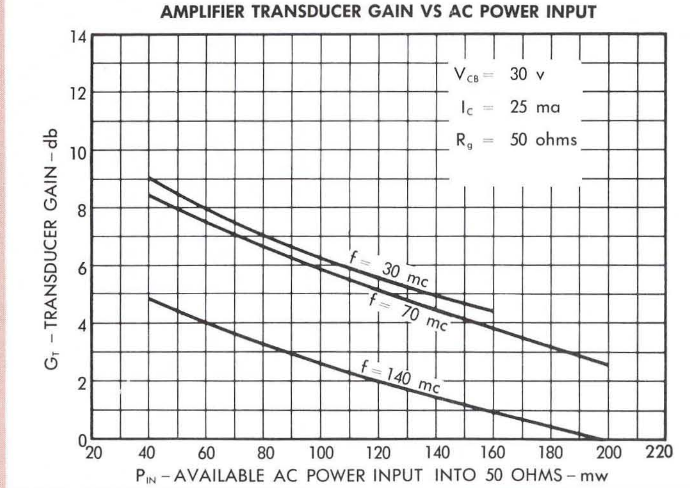
GAIN – BANDWIDTH VS V_{CE} AND I_C



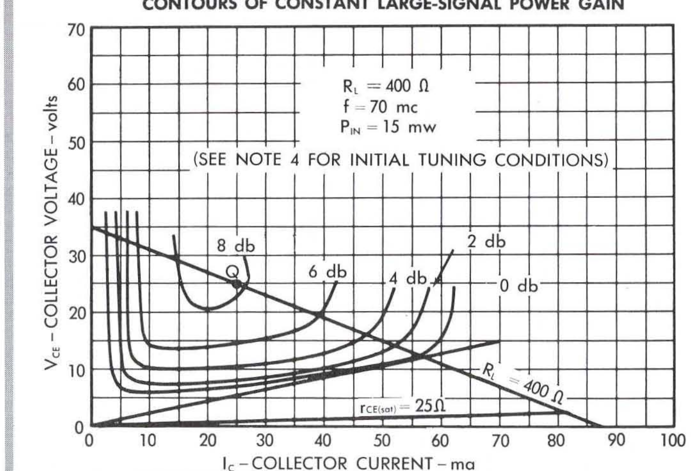
OSCILLATOR POWER OUTPUT VS FREQUENCY



AMPLIFIER TRANSDUCER GAIN VS AC POWER INPUT



CONTOURS OF CONSTANT LARGE-SIGNAL POWER GAIN

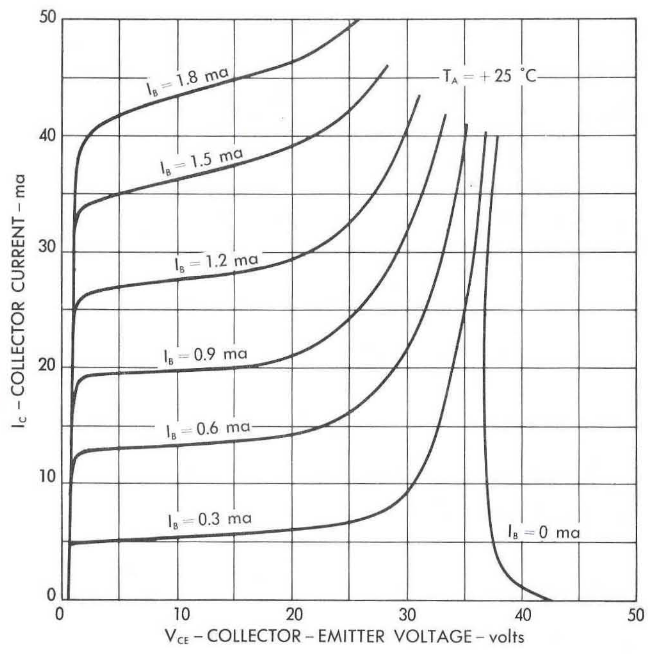


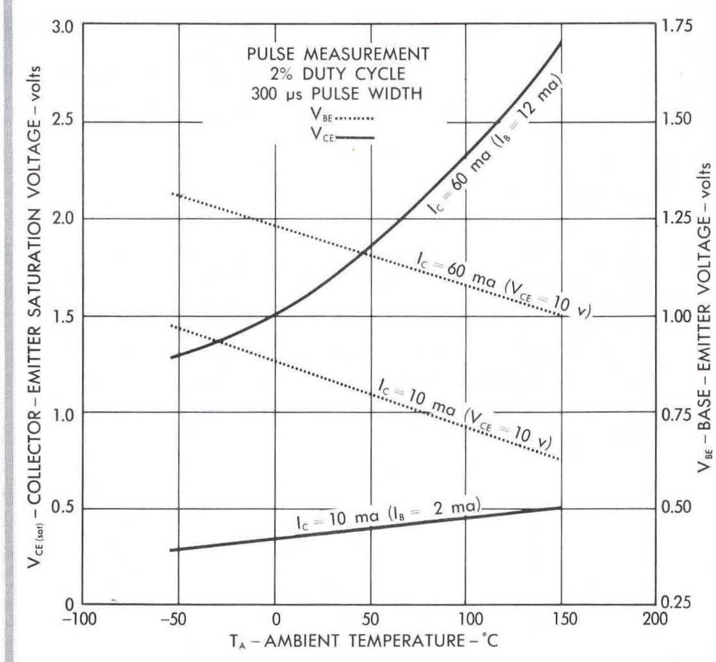
Note 3 Derate linearly to +175°C case temperature at the rate of 8 mw/°C.

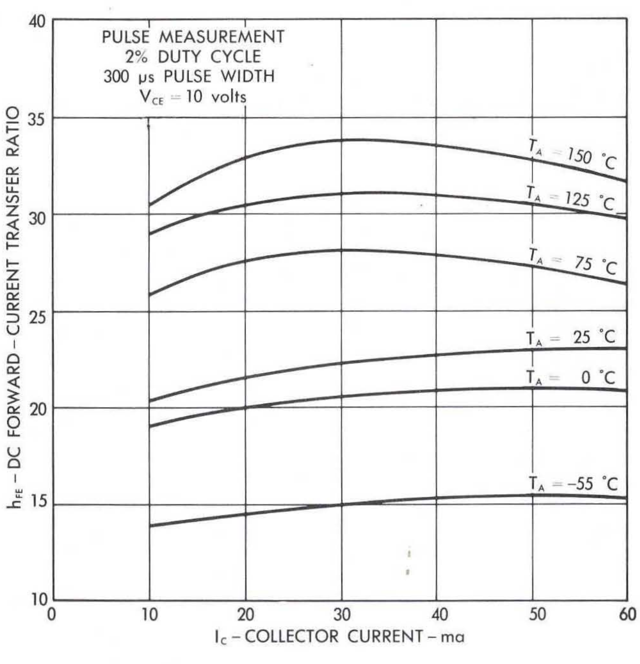
Note 4 Each power gain contour is obtained at P_{IN} = 15 mw from an amplifier circuit tuned at V_{CB} = 25 v, I_C = 25 ma, P_{IN} = 60 mw (Point Q). These contours define all instantaneous collector voltages and corresponding collector currents for the specified constant power gain.

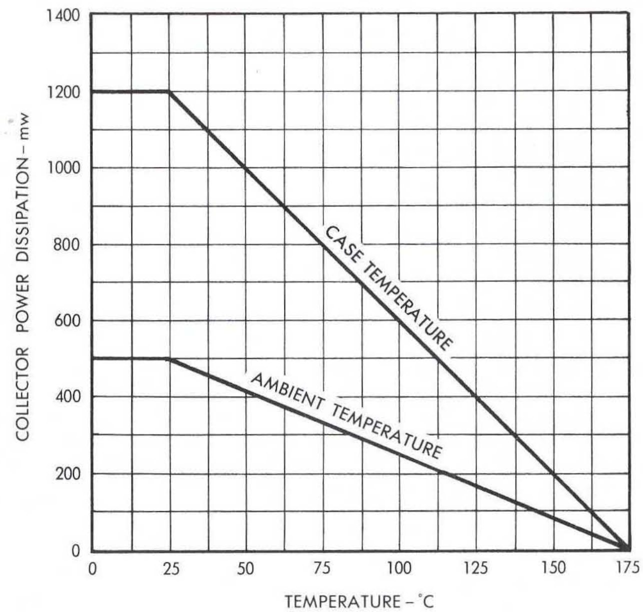
Note 5 To obtain f_T, the $|h_{fe}|$ response with frequency is extrapolated at 6db/octave to $|h_{fe}| = 1$ from a measurement of the frequency at which $|h_{fe}| = 2$. The product of $f_T \times 1$ has been referred to as the gain-bandwidth.

TYPICAL CHARACTERISTICS









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Note 1 The voltage at which h_{FB} approaches one when the emitter-base diode is open circuited. This value can be exceeded in applications where the dc circuit resistance (R_{BE}) between base and emitter is a finite value. When a reverse voltage is applied to the emitter-base diode, a peak collector-emitter voltage equal to BV_{CBO} minus V_{EB} can be allowed. Such conditions may be encountered in class B or C amplifiers and oscillators.

Note 2 Derate linearly to +175°C ambient at the rate of 3-1/3 mw/°C.