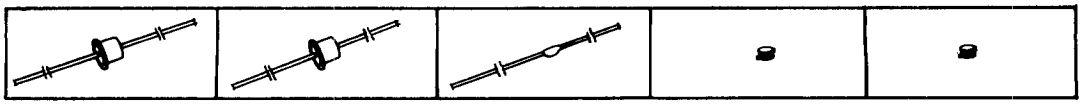
TUNNEL DIODES

PACKAGES



APPLICATIONS

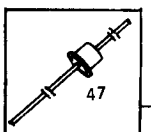
UHF Oscillator Level Detector Peak Sensing Frequency Divider Converter High Speed Logic Sampling Circuits	Detectors Mixers Limiters Compressors Power Monitors	Fast rise time pulse generators Amplitude Discriminator Sampling Circuits Fast threshold detectors Ultra High Speed Logic Level Sensing	Amplifiers and self oscillating mixers through X band Phase array radar Frequency converters Low level digital phase shifters Pulse position modulators	Doppler mixers Detectors Limiters Compressors

TYPES AVAILABLE

FREQUENCY IN GHz (F_{RO})					
65				**TD400** **Tunnel Diodes** **Microwave**	**BD400** **Back Diodes** **Microwave**
40					
20			**TD260** **Tunnel Diodes** **Ultra High Speed** **Switch**		
3.4	**1N3712** **Tunnel Diodes** **General Purpose**	**BDI** **Back Diodes** **General Purpose**			
DC					

FEATURES

• Low Cost • Hermetically Sealed • Electrically & Mechanically Rugged • Mil. Versions Available	• Low Cost • Hermetically Sealed • Electrically & Mechanically Rugged	• Very fast switching. • Very stable at elevated operating temperatures. • Low functional cost.	• Controlled negative conductance • Controlled cutoff frequencies • Low noise • Low package inductance • Stable at elevated operating temperatures	• Low capacitance • Low inductance • Low "on" voltage • Very high frequency capability • Low I/F noise ratio



TUNNEL DIODES
GENERAL PURPOSE

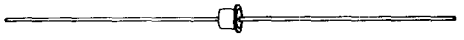
+100°C Operation TD-1	I_P Peak Point Current (mA)	I_V Valley Point Current Max. (mA)	C Capacitance Max. (pF)	V_P Peak Point Voltage Typ. (mV)	V_V Valley Voltage Typ. (mV)	V_{FP} Forward Peak Voltage Typ. (mV)	R_S Series Resist. Max. (Ohms)	$-G$ Negative Conductance (mhos × 10^{-6})	f_{RO} Resistive Cutoff Frequency Typical (GHz)
1N3712	1.0 ± 10%	0.18	10	65	350	500	4.0	8 Typ.	2.3
1N3713 [1]	1.0 ± 2.5%	0.14	5	65	350	510	4.0	8.5 ± 1	3.2
1N3714	2.2 ± 10%	0.48	25	65	350	500	3.0	18 Typ.	2.2
1N3715 [1]	2.2 ± 2.5%	0.31	10	65	350	510	3.0	19 ± 3	3.0
1N3716	4.7 ± 10%	1.04	50	65	350	500	2.0	40 Typ.	1.8
1N3717 [1]	4.7 ± 2.5%	0.60	25	65	350	510	2.0	41 ± 5	3.4
1N3718	10.0 ± 10%	2.20	90	65	350	500	1.5	80 Typ.	1.6
1N3719 [1]	10.0 ± 2.5%	1.40	50	65	350	510	1.5	85 ± 10	2.8
1N3720	22.0 ± 10%	4.80	150	65	350	500	1.0	180 Typ.	1.6
1N3721 [1]	22.0 ± 2.5%	3.10	100	65	350	510	1.0	190 ± 30	2.6
TD-9	0.5 ± 10%	0.10	5	60	—	—	6.0	4.0 Typ.	1.3

[1] Mil. Versions Available.

Germanium Diodes

1N3712-21

The General Electric 1N3712 through 1N3720 and 1N3713 through 1N3721 are Germanium Tunnel Diodes offering peak currents of 1.0, 2.2, 4.7, 10, and 22 ma. These devices, which make use of the quantum mechanical tunneling phenomenon to obtain a negative conductance characteristic, are designed for low level switching and small signal applications at very high frequencies. All 1N3713-1N3721 version parameters are closely controlled for use in critical applications such as level detection, frequency converters, etc. These devices are housed in General Electric's new hermetically sealed subminiature axial package.



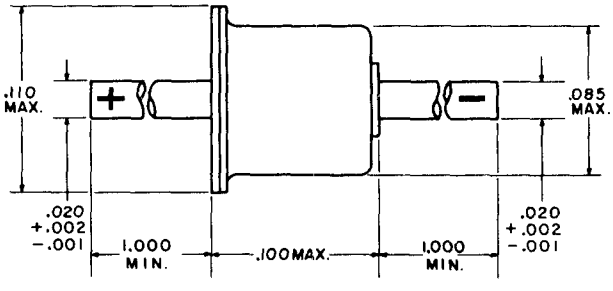
FEATURES:

- **V_{FS} Specified for more accurate designing of load lines**
- **Low capacitance**
- **Fast speed**

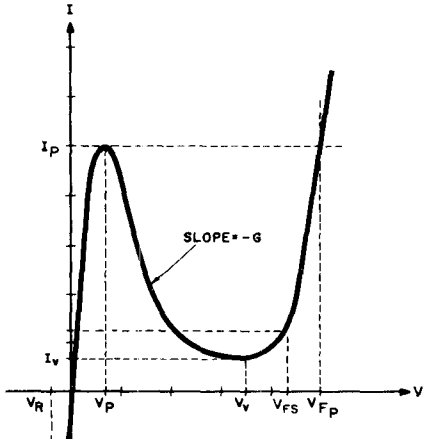
	1N3712 1N3713	1N3714 1N3715	1N3716 1N3717	1N3718 1N3719	1N3720 1N3721	
Forward Current*	5	10	25	50	100	ma
Reverse Current*	10	20	50	50	100	ma
Storage Temperature	←		−55 to +100		→	°C
Lead Temperature $\frac{1}{16}'' \pm \frac{1}{32}''$ from case for 10 seconds	←		260		→	°C

*Derate maximum currents 1% per °C ambient temperature above 25°C.

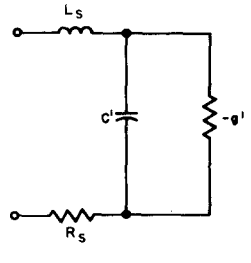
AXIAL DIODE OUTLINE



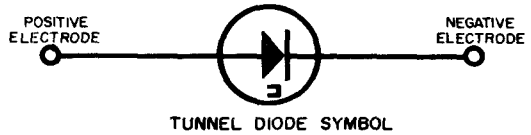
ALL DIMENSIONS IN INCHES.
DIMENSIONS ARE REFERENCE UNLESS TOLERANCED.



TYPICAL STATIC CHARACTERISTIC CURVE



EQUIVALENT CIRCUIT (BIASED IN NEGATIVE CONDUCTANCE REGION)



TUNNEL DIODE SYMBOL

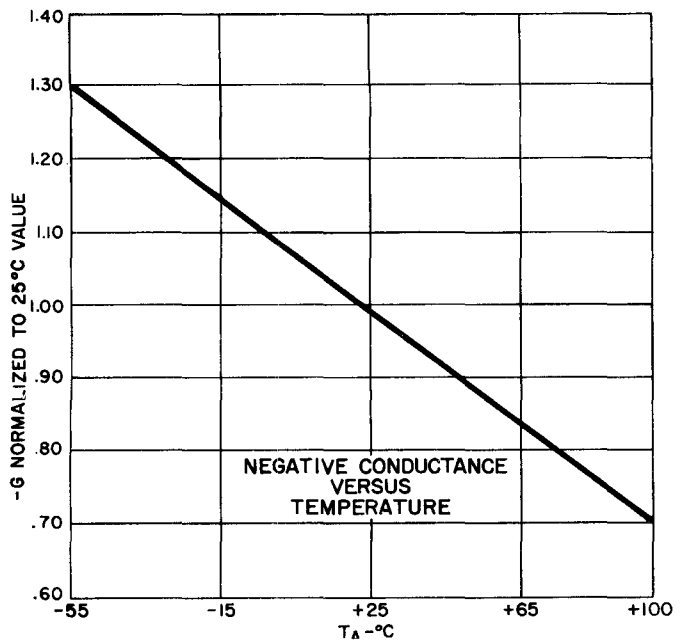
electrical characteristics:

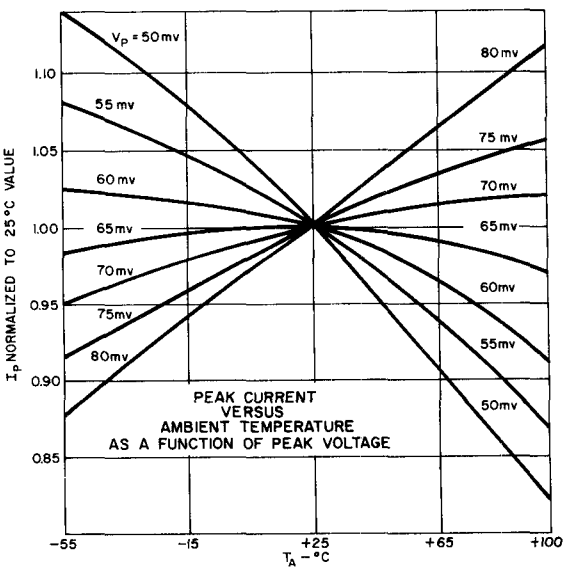
STATIC CHARACTERISTICS		1N3712			1N3713			1N3714			1N3715		
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
Peak Point Current	I_P	0.9	1.0	1.1	0.975	1.000	1.025	2.0	2.2	2.4	2.15	2.20	2.25
Valley Point Current	I_V		0.12	0.18	.075	.095	.140		0.29	0.48	.165	.210	.310
Peak Point Voltage	V_P		65		58	65	72		65		58	65	72
Valley Point Voltage	V_V		350		315	355	395		350		315	355	395
Reverse Voltage ($I_R = I_P$ typ.)	V_R			40		20	40			40		20	40
Forward Voltage ($I_F = I_P$ typ.)	V_{FP}		500		475	510	535		500		475	510	535
► ($I_F = .25\ I_P$ typ.)	V_{FS}*				410	450					410	450	
DYNAMIC CHARACTERISTICS													
Total Series Inductance	L_S		0.5			0.5			0.5			0.5	
Total Series Resistance	R_S		1.5	4.0		1.7	4.0		1.0	3.0		1.1	3.0
► Valley Point Terminal Capacitance	C		5	10		3.5	5.0		10	25		7.0	10.0
Max. Negative Terminal Conductance	-G		8		7.5	8.5	9.5		18		16	19	22
Resistive Cutoff Frequency	f_{ro}		2.3			3.2			2.2			3.0	
Self-Resonant Frequency	f_{xo}		3.2			3.8			2.2			2.7	
Frequency of Oscillation	F_{osc}**		3.2			3.8			2.2			2.7	
► Rise Time	t_r***					1.7						1.6	

*V_{FS} is defined as the value of forward voltage at a forward current of one quarter the typical peak current.

**The frequency of oscillation (under short circuit conditions) for steady state large signal sinusoidal oscillation is given by equation (3) which is the maximum frequency attainable without capacitance compensation.

***Switching speed with constant current drive. $t_r \approx \frac{V_{FP} - V_P}{I_P - I_V} C$



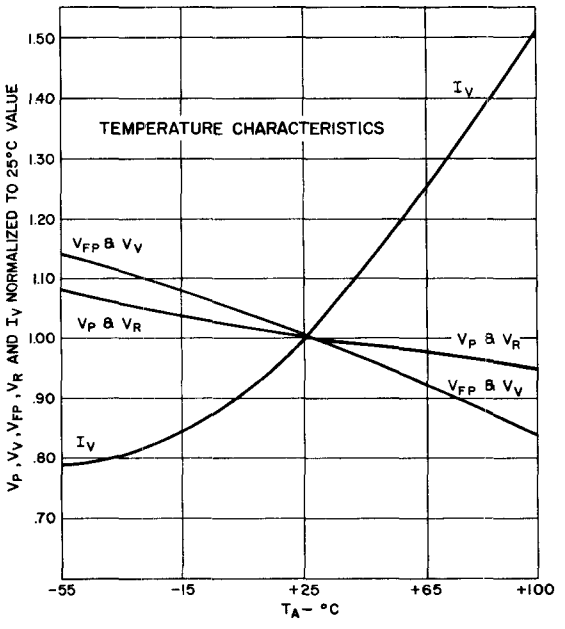


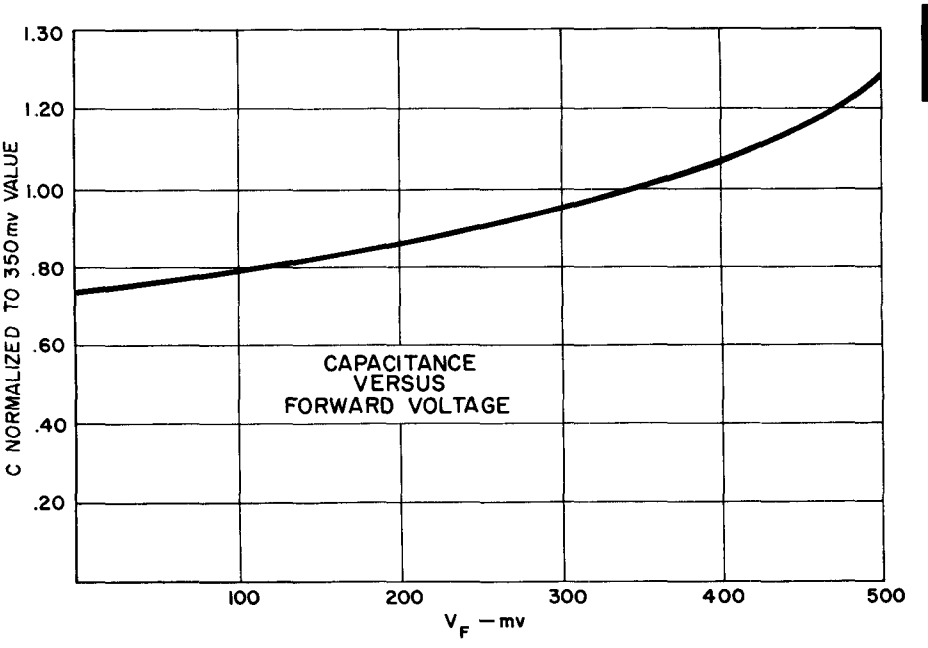
1N3716			1N3717			1N3718			1N3719			1N3720			1N3721			
Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
4.2	4.7	5.2	4.58	4.70	4.82	9.0	10.0	11.0	9.75	10.00	10.25	20	22	24	21.5	22	22.5	ma
	0.60	1.04	.350	.45	.60		1.3	2.2	.75	.95	1.40		2.9	4.8	1.65	2.10	3.10	ma
	65		58	65	72		65		58	65	72		65		58	65	72	mv
	350		315	355	395		350		315	355	395		350		315	355	395	mv
		40		20	40			40		20	40			40		20	40	mv
	500		475	510	535		500		475	510	535		500		475	510	575	mv
			410	450					410	450					410	450		
	0.5			0.5			0.5			0.5			0.5			0.5		nh
	.50	2.0		.52	2.0		.30	1.5		.36	1.5		.20	1.0		.22	1.0	ohms
	25	50		13	25		50	90		27	50		90	150		55	100	pf
	40		36	41	46		80		75	85	95		180		160	190	220	10^{-3} mho
	1.8			3.4			1.6			2.8			1.6			2.6		KMC
	1.4			1.9			.97			1.3			.67			.78		KMC
	1.4			2.0			1.0			1.4			.74			.95		KMC
				1.4						1.3						1.2		nsec

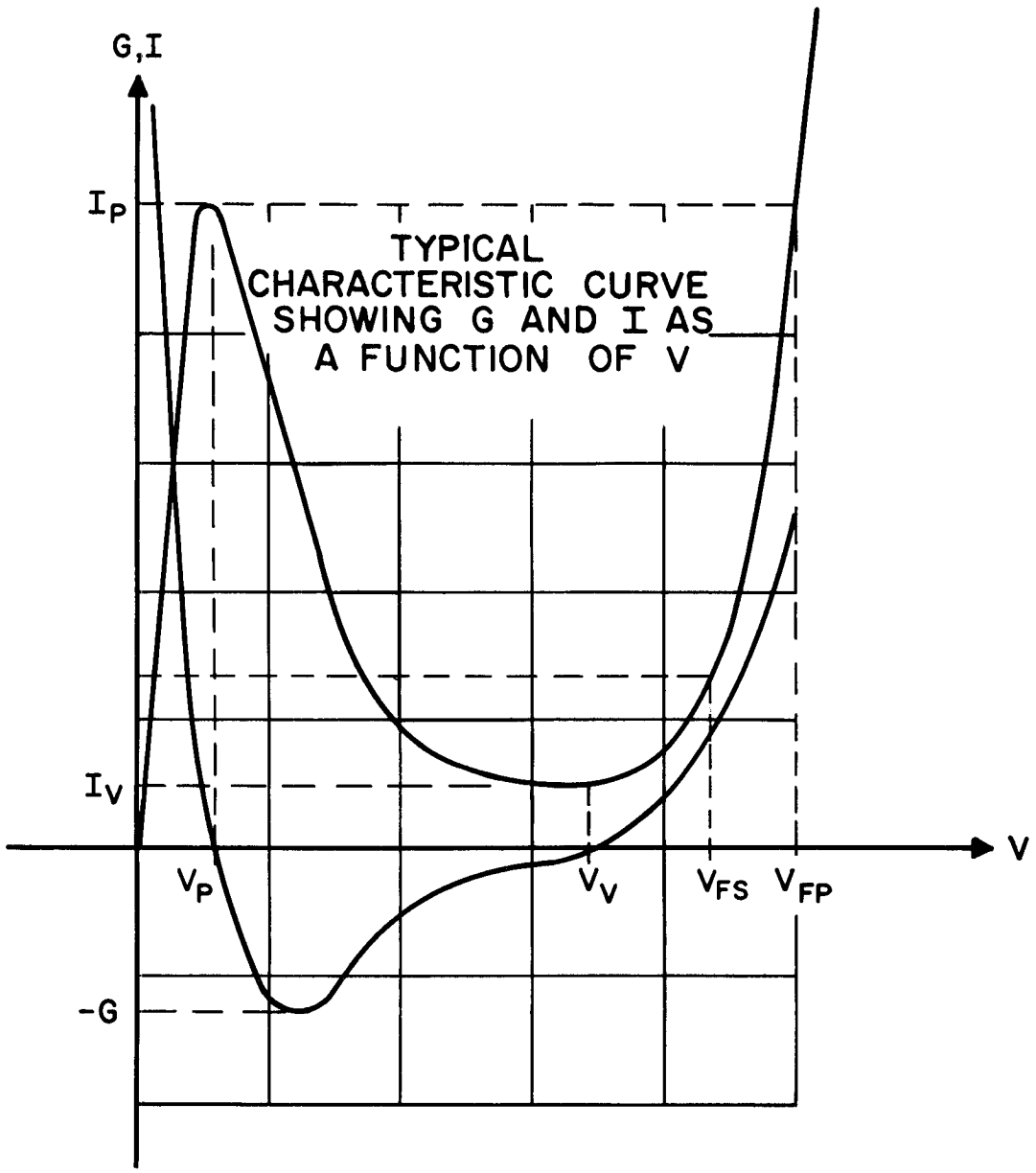
$$f_{ro} = \frac{|g'|}{2\pi C'} \sqrt{\frac{1}{R_S |g'|} - 1} \quad (1)$$

$$f_{xo} = \frac{1}{2\pi} \sqrt{\frac{1}{L_S C'} - \left(\frac{|g'|}{C'}\right)^2} \quad (2)$$

$$f_{osc} = \frac{1}{2\pi} \sqrt{\frac{1}{L_S C} - \left(\frac{R_T}{L}\right)^2} \quad (3)$$






G,I
I_P
I_V
-G
V
V_P
V_V
V_{FS}
V_{FP}
TYPICAL CHARACTERISTIC CURVE SHOWING G AND I AS A FUNCTION OF V