HEWLETT PACKARD

Coaxial Step Recovery Diode Modules (Impulse Train Generators)

Technical Data

33002A/B
33003A/B
33004A/B
33005C/D

Features

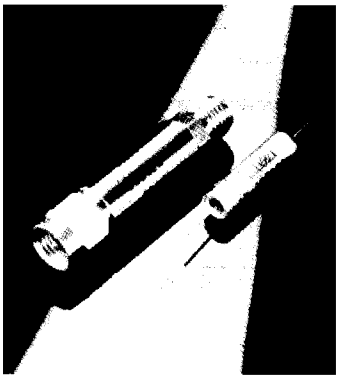
- **Various Drive Frequencies Available**
  100, 250, 500,1000 MHz
- **Narrow Output Pulses**
  130 Picosecond Pulse Width with 10 Volt Amplitude
- **Broadband Output Comb**
  Useful Power at Each Harmonic through 18 GHz
- **Input Matched to 50 Ω**
- **Self-Biased**
  No External Bias Required
- **Reliable**
  Rugged, Reliable Solid State Hybrid Integrated Design

Description

These units are integrated step recovery diode "impulse train" generating circuits matched to 50 Ω at the input frequency. All circuit elements necessary to produce the impulse train are integrated into the hermetically sealed cylindrical module. All internal joints are welded or thermocompression bonded for high reliability. Modules are also available mounted in a 3 mm connector housing containing a DC return which self-biases the diode.

Applications

When driven at the appropriate input frequency, the output of these devices is a train of narrow, high amplitude pulses at a repetition rate equal to the input frequency. The resulting "comb" spectrum consists of lines at all multiples of f_{IN} up to and beyond 18 GHz. The outputs are useful in many applications such as: measurement of the spectral behavior of various linear components (filters and slow wave structures); frequency and amplitude calibration of receivers, systems, and antennas; frequency marking systems; reference frequency generation for phase locked systems; sampling phase-lock systems; local oscillator drivers for coherent receiving techniques; multipliers; and pulse circuit applications.



In addition to drive frequencies of 100 MHz, 250 MHz, 500 MHz, and 1000 MHz, other drive frequencies (any frequency between 50 MHz and 3000 MHz) are available on special order.

Specifications at T_{CASE} = 25°C

Maximum Ratings

Maximum Power at Input Frequency[1]	1.0 W
Maximum Operating Temperature	125°C

Note:
1. Derate to 0.5 W at 125°C.

Specifications at T_{CASE} = 25°C (cont.)

Input Specifications

Model Number	Input Frequency
33002A/B	100 ± 5 MHz (useful at slightly reduced performance 100 ± 10 MHz)
33003A/B	250 ± 12.5 MHz (useful at slightly reduced performance 250 ± 25 MHz)
33004A/B	500 ± 25 MHz (useful at slightly reduced performance 500 ± 50 MHz)
33005C/D	1000 ± 50 MHz (useful at slightly reduced performance 1000 ± 100 MHz)
Input SWR for all Models	Less than 2:1 at center frequency

Typical Output Pulse Characteristics, 0.5 W Drive

Model Number (Drive Frequency)	Pulse Height (V) Typ.	Pulse Width(ps) Typ.
33002A/B (100 MHz)	15	130
33003A/B (250 MHz)	15	130
33004A/B (500 MHz)	15	130
33005C/D (1000 MHz)	10	130

Line Spectra, 0.5 W Drive

Model Number	Power Output per Line (dBm)							
	f_{IN}* to 4 GHz		4-8 GHz		8-12.4 GHz		12.4-18 GHz	
	Min.	Typ.†	Min.	Typ.†	Min.	Typ.†	Min.	Typ.†
33002A/B (100 MHz)	-15	-5	-25	-15	-30	-25	-	-35
33003A/B (250 MHz)	-5	0	-15	-5	-20	-15	-	-30
33004A/B (500 MHz)	+5	+10	-5	+5	-15	-5	-	-15
33005C/D (1000 MHz)	+5	+10	0	+5	-10	0	-15	-5

*Fundamental line excluded.
†Midband, see Figures 7-10.

Mechanical Characteristics

Size ..... See outline drawing
Weight ..... 10 grams
Materials
B and D versions ..... outer case and leads - Kovar
A and C versions ..... outer case and connections - stainless steel
Finish
B and D versions ..... Gold plated, 50 microinch minimum
A and C versions ..... Stainless steel

Temperature Effects

The comb generator is designed to operate over wide ambient temperatures (-55°C to +125°C). The SWR remains below 2:1 and typical spectral line power variation is about ±2 dB over this temperature range.

Bias

The circuit diagrams are shown in Figure 1. The "A" and "C" versions are complete comb generators with DC return and require no external bias. The module ("B" and "D" versions, no connectors) can be biased from either end by using a bias tee.

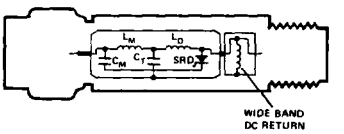


Figure 1a. Electrical Schematic of "A" and "C" Versions.

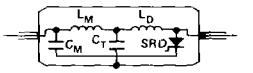


Figure 1b. Electrical Schematic of "B" and "D" Versions.

Environmental Characteristics

Temperature Storage	-55°C to +125°C
Temperature Operating	-55°C to +125°C
Temperature Cycling	MIL-STD-750, Method 1051
	Test Condition A
Temperature Shock	MIL-STD-750, Method 1056
	Test Condition A ("B" and "D" versions only)
Moisture Resistance	MIL-STD-750, Method 1021
Shock (nonoperating)	MIL-STD-750, Method 2016
	5 blows each X_1, Y_1, Y_2 orientations
	0.5 ms, 1500 g's
Vibration Fatigue	MIL-STD-750, Method 2046

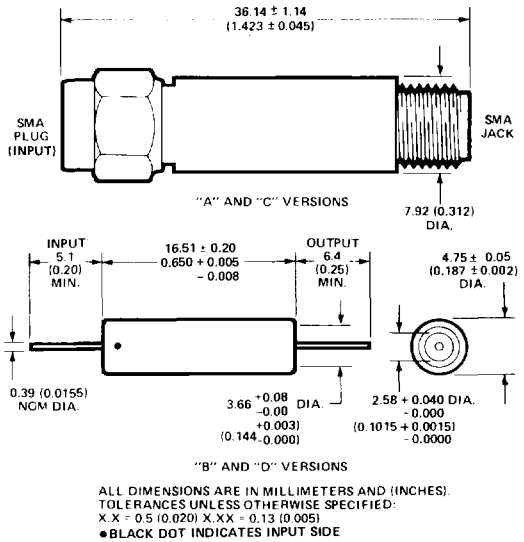


Figure 2. Mechanical Outlines.

The output of these devices consists of a train of very short pulses periodic with the input frequency.

In the time domain, the output is characterized by the pulse height, pulse width and the excess feed-through of the fundamental frequency component to the output.

In the frequency domain the output consists of power at all frequencies which are integral multiples of f_{IN} up to and beyond 18 GHz. All specifications are for 0.5 watt drive at 25°C case temperature.

Time Domain

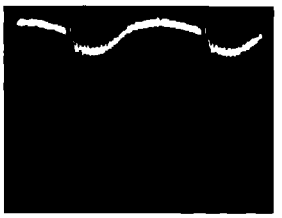


Figure 3. Impulse Waveform 33002A/B (100 MHz).

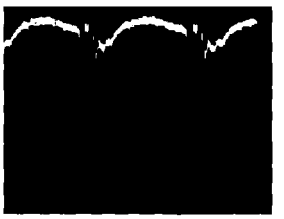


Figure 4. Impulse Waveform 33003A/B (250 MHz).

Figure 5. Impulse Waveform 33004A/B (500 MHz).

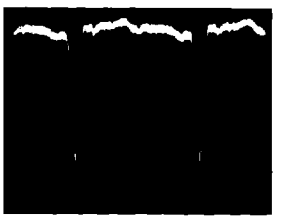


Figure 6. Impulse Waveform 33005C/D (1000 MHz).

Frequency Domain

In the frequency domain the output is characterized by a line spectrum. The spacing of the lines is equal to the input frequency. Fundamental frequency feed-through is approximately 15 dBm with 27 dBm input power.

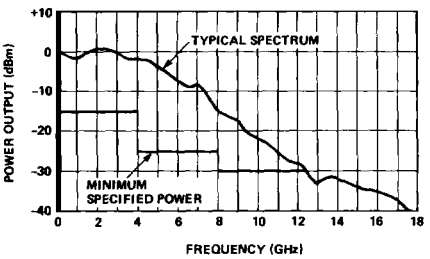


Figure 7. Spectrum Envelope of 33002A/B (100 MHz).

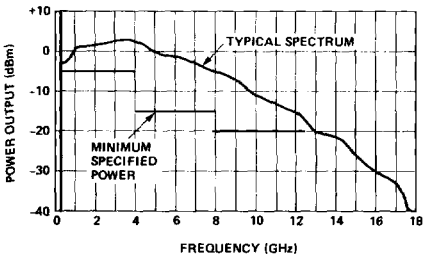


Figure 8. Spectrum Envelope of 33003A/B (250 MHz).

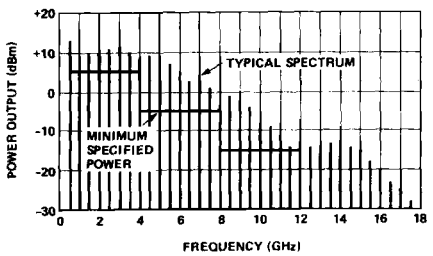


Figure 9. Spectrum Envelope of 33004A/B (500 MHz).

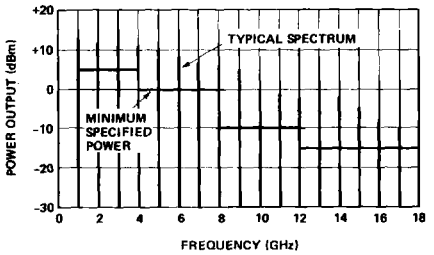


Figure 10. Spectrum Envelope of 33005C/D (1000 MHz).

Input SWR

The input SWR is a function of the input power. The devices have all been optimized for minimum SWR at the nominal center frequency with 0.5 watt drive. Below 0.5 watts, the SWR begins increasing. The point of minimum SWR may be adjusted if external bias is applied to the diode ("B" and "D" versions only, which have no DC return).

SWR Characteristics

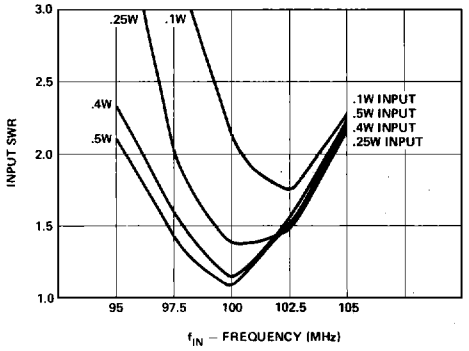


Figure 11. 33002A/B

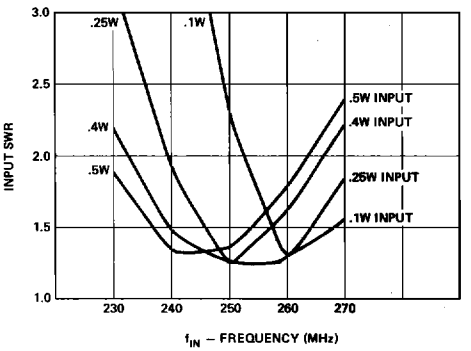


Figure 12. 33003A/B.

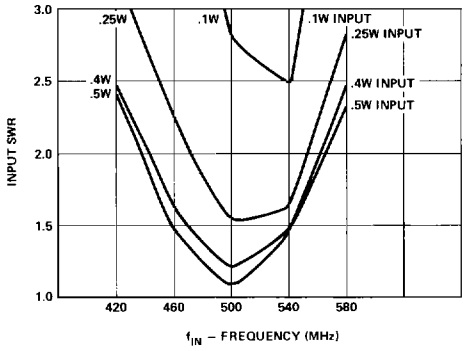


Figure 13. 33004A/B.

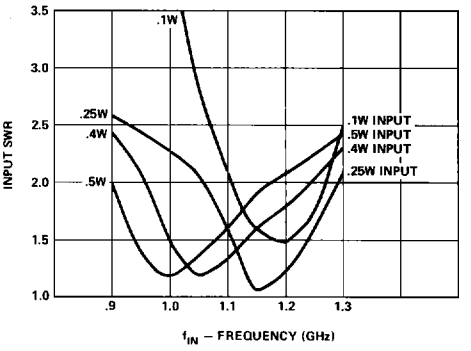


Figure 14. 33005C/D.

Test Setups

Comb generators can be measured in the time domain using a very fast sampling scope, or in the frequency domain using several sweepers (as local oscillators), mixers and an IF amplifier. Measurements made using a spectrum analyzer must be interpreted very carefully because of the large number of spurious responses when driven by the extremely wideband comb generated by these devices. Use of a tracking preselector (HP 8445B) helps eliminate these spurious responses.