DD111: Directional Detector for WR340 Waveguide

General Description

DD111 is a small-housing directional detector that is intended for sampling incident or reflected waves in high-power 2.45 GHz industrial applications using a WR340 (R26) rectangular waveguide. This detector combines the following components:

- Directional coupler
- Attenuator
- Tunnel diode detector

The detector delivers well-scaled DC voltage approximately proportional to the power of a wave propagating in one direction in the parent waveguide. The use of the tunnel diode provides an improved temperature stability of the output voltage and a low video resistance for fast pulse rise/fall times.

Fig. 1. Directional detector DD111.

The detector transfer curve is generally nonlinear and varies with temperature. A transfer curve of an "average detector" is presented in this datasheet.

The detector module is fastened to a parent waveguide by means of six M3 or similar-diameter screws after machining of appropriate holes in the waveguide wall. Simply reversing the module causes it to sample the wave propagating in the opposite direction.

As an option, an assembly consisting of one module or two reverse-oriented modules affixed to a precisely machined parent waveguide with the standard length 174 mm can be provided.

Specifications

Waveguide of destination	WR340 (R26)
Waveguide wall thickness	2 mm
Waveguide surface flatness required at DD interface	0.04 mm
Frequency range	2425 – 2475 MHz
Maximum working power	16 kW
Directivity	25 dB min
Output voltage polarity	Negative
Video resistance (typical)	250 Ω
Internal output capacitance	1500 pF
Statistical spread of output voltage	± 1 dB (3-σ deviation)
Output voltage temperature variation (+5 °C to +65 °C)	< 0.5 dB
Dimensions	$46 \times 49.5 \times 22$ mm
Mass	70 g
Operating temperature range	-10 °C to +65 °C
Storage temperature range	-20 °C to +80 °C
Output connector	SMA female (SMAf)

Detector Correction Curve

A detector correction curve is the inverse of the transfer curve $V = f(P)$, where P is the power of a wave propagating in the waveguide in a given direction and V is the output voltage. The correction curve can be used, in particular in its mathematical form, for determining the input power from the output voltage. A typical correction curve for an ambient temperature 25 °C, frequency 2450 MHz, and load resistance $R_L = 33$ kΩ, is shown in Fig. 2 below.
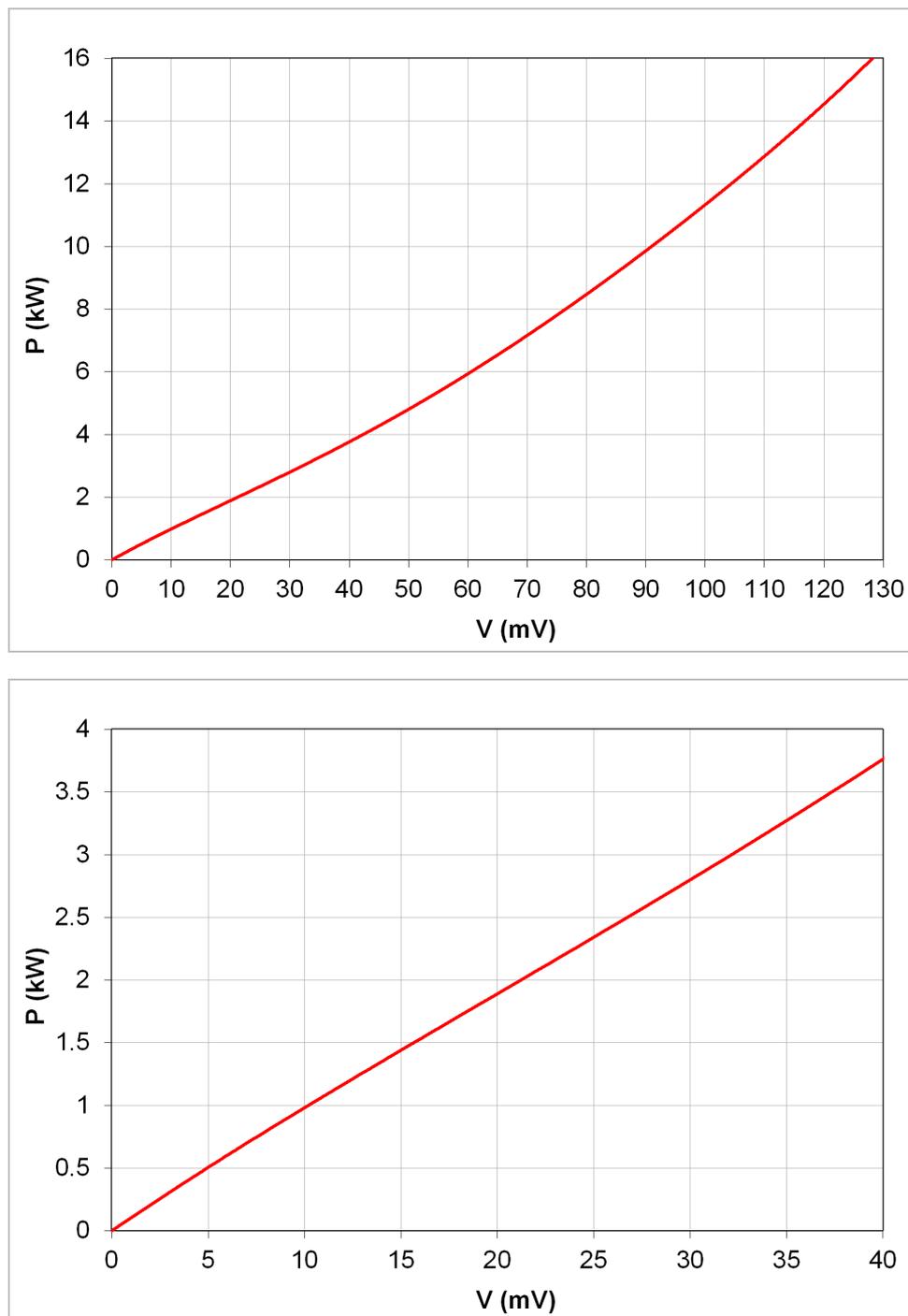

Fig. 2. Typical DD111 correction curve.

The curve can be approximated by the polynomial

$$P = d_1 V + d_2 V^2 + d_3 V^3 + ... + d_n V^n$$

where P is the input microwave power in kilowatts, V is the output voltage in millivolts, and d_i are the polynomial coefficients listed below.

Tab. 1. Polynomial coefficients for DD111 correction curves.

Coefficient	Value
d_1	1.0537451E-01
d_2	-8.9899544E-04
d_3	2.0879498E-05
d_4	-1.5362224E-07
d_5	4.2649132E-10

Please be aware that the function is a statistical average based on evaluation of a number of detectors, and generally depends on temperature. The behavior of individual detectors may vary.
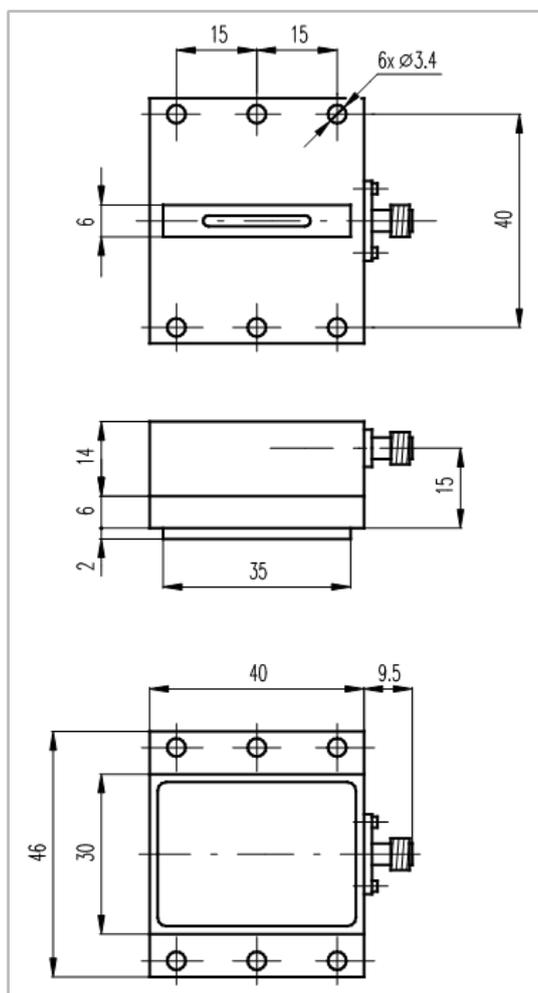
Dimensional Drawing

Fig. 3. Basic DD111 dimensions. All dimensions are in millimeters.
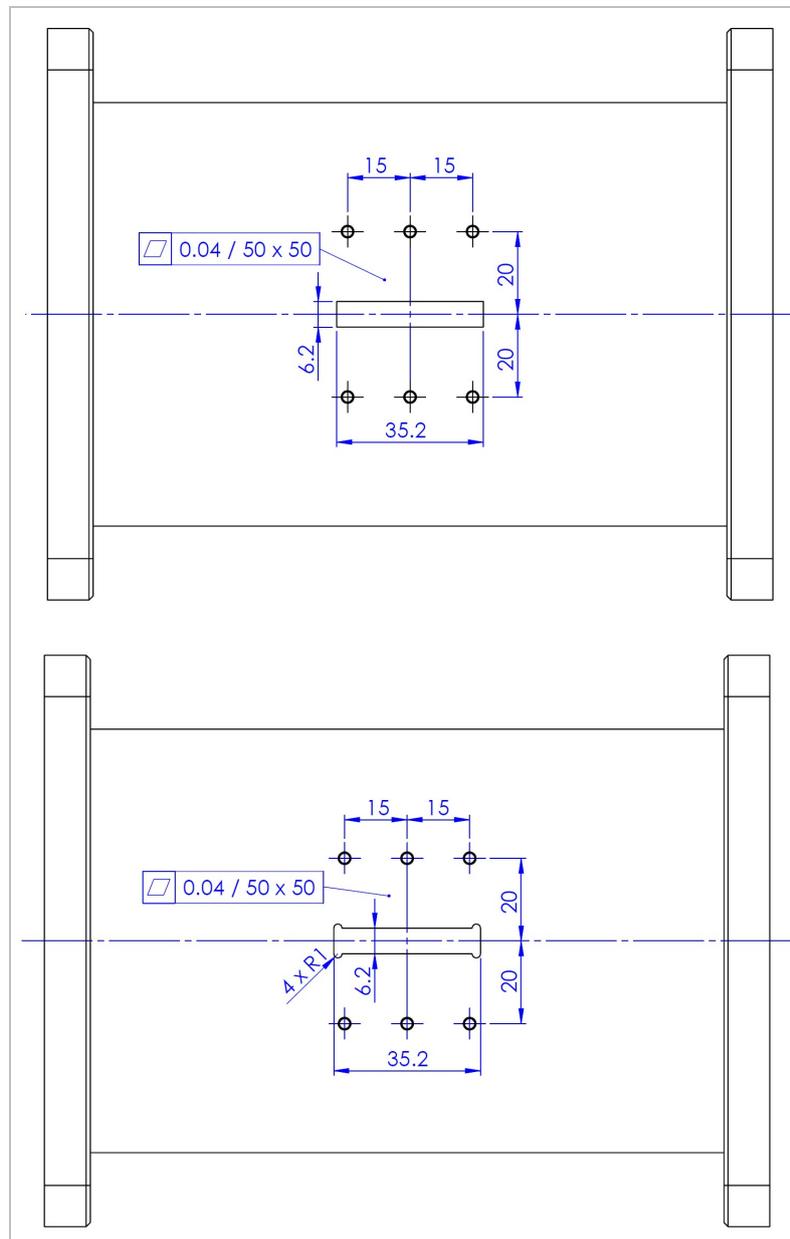
Waveguide Machining Template

Fig. 4. Waveguide machining templates. All dimensions are in millimeters. The bottom alternative is for a better manufacturability. The waveguide wall thickness must be 2 mm. Suggested are M3 x 8 screws (stainless or galvanized steel).

Important Note

Complying with the specified waveguide wall thickness and flatness of its surface interfacing with the detector is essential in order to achieve the specified measurement accuracy. The wall thickness should not deviate from the specification by more than ±0.3 mm, as otherwise DD directivity will deteriorate.

To avoid problems with manufacturing precision waveguide components, one can order a calibrated assembly consisting of a DD module fixed to a parent waveguide. The standard waveguide length is 174 mm.