What kind of HEPA filter unit do you need?

This depends on how much information you have about your building's ventilation system.

Abbreviations and Definitions:

HVAC: Heating, Ventilation, and Air Conditioning. Essentially the environmental control system of the air in a building.

MERV: Minimum Efficency Reporting Value. Used to describe the efficiency of filters used on recirculated air in a building's HVAC system. The current standard is MERV 8, which has 35% efficiency at filtering out particles 1-6 microns in size. The higher the MERV number, the greater the efficiency of the filter, and the smaller the particles the filter can remove.

HEPA: High Efficiency Particulate Arresting filters. HEPA filters, as defined by the United States Department of Energy (DOE) standard adopted by most American industries, remove at least 99.97% of aerosols 0.3 micrometers (µm) in diameter.

ASHRAE: American Society of Heating, Refrigeration, and Air Conditioning Engineers. They create the standards to which HVAC systems are constructed and maintained.

ACH: Air Changes Per Hour. The number of times the air in a room is completely changed out and replaced with outside air. ACH figures are room-size dependent.

CADR: Clean Air Delivery Rate. Typically given in cubic feet per minute (see below). Used to describe the filtering output of a HEPA or similar type air filter.

CFM: Cubic feet per minute. Used to indicate the volume of air a ventilation system or filtration unit can provide in one minute. HVAC systems and filtering units may provide this measure, which is independent of the size of a room or building. The CFM value x 60 minutes gives cubic feet per hour.

Detailed Calculation Procedure (requires specialized information):

- Find the total volume of the room (floor area x height) in cubic feet
- Find out the HVAC supply airflow rate in cubic feet per minute (typically this information in only available from your building environmental engineer)
- How much of the supplied air is outside air in cubic feet per minute? If unknown, assume zero (again, this is building environmental engineer-level information)
- How much of the supplied air is recirculated in cubic feet per minute? (ditto)
- What kind of filter does the HVAC system have?

Calculate the air changes per hour (ACH) of outside air:
Multiply the outside air rate per minute x 60 minutes
Divide the total by the volume of the room = ACH

Calculate the equivalent air changes per hour of the recirculated air:
Multiply the recirculated air rate per minute x 60 minutes
Multiply the total by the efficiency rating for the filter
Divide the total by the volume of the room = equivalent ACH

How many ACH do you want? Sum the outside air changes and the equivalent air changes. If the total does not meet the desired ACH, and windows are not an option, use a HEPA filter unit to cover the difference. Here are two examples:

Example 1 (basic level real world example from the author's university):

You have a 15 x 15 x 8 voice studio (1,800 cu. ft). The only available information from the university is "the ACH in faculty offices is at least 4-6 ACH, and it is a combination of outdoor and recirculated/filtered air." MERV 8 filters are supposedly in use.

For the sake of safety, assume that the combined total ACH (outside air changes plus filtered equivalent air changes) is 4 ACH – the bottom figure in the university's information. What would the effect of a portable HEPA filter unit be on the ACH in the studio?

The author's HEPA filter unit has a CADR of 233 cfm for smoke particles (similar in size to viral particles) when running at maximum setting (has three fan settings).

233 cfm x 60 min = 13,980 cfh.
13,980 cfh / 1,800 cf office = 7.77 equivalent ACH to supplement the HVAC system air changes.

HOWEVER, check unit specifications to see the CADR levels if your filter unit has multiple fan speed settings. Quieter modes of operation mean less ACH.

Example 2 (from ASHRAE "In-Room Air Cleaner Guidance for Reducing COVID-19 In Your Space/Room," https://www.ashrae.org/file%20library/technical%20resources/covid-19/in-room-air-cleaner-guidance-for-reducing-covid-19-in-air-in-your-space-or-room.pdf, dated January 21, 2021):

You have a 45 x 20 x 9 ft room (8100 cu. ft). The HVAC system supplies 1,200 cfm, of which 350 cfm is outdoor air; there is a MERV 8 filter (35% efficiency for 1-6 micron particles).

ACH of outside air:
350 cfm x 60 mins = 21,000 cfh
21,000 cfh / 8100 cf room volume = 2.6 ACH

Equivalent ACH from recirculated air:
1,200 cfm total – 350 cfm outside = 850 cfm recirculated
850 cfm x 60 min = 51,000 cfh
51,000 cfh x 0.35 efficiency of filter = 17,850 cfh
17,850 cfh / 8100 cf room volume = 2.2 equivalent ACH

If you want 6 air changes per hour…
Currently have 2.6 ACH outside air plus 2.2 equivalent = 4.8 ACH.
To get 1.2 ACH more, you will need a filter with a clean air delivery rate (CADR) of 165 cfm:
165 cfm x 60 mins = 9,900 cfh
9,900 cfh / 8100 cf room volume = 1.22 equivalent ACH.