



- 1 Threefold-module, with mounts for single-use syringes from Braun from 1 to 10 ml and Hamilton glass syringes of 100 μ l.
- 2 Threefold syringe pump module for chemical feed/metering.

SYRINGE PUMP KIT FOR FLEXIBLE INTEGRATION IN CUSTOMIZED DEVICES

Introduction

Syringe pumps are established instruments for transportation of liquids and gases. They are used in fluidic applications, analysis devices, and test platforms. Fraunhofer IMM develops and successfully applies syringe pumps in the scale of milli- to nanoliter for the generation of highly precise flow with a minimal pulsation. We do rely on many years of experience in developing individual actuators for fluidic systems and offer a huge portfolio of solutions. Generally, the syringe pumps are designed to the customer's specific application and are optimized with respect to parameters such as precision, feed rate, delivery volume, and/or backpressure.

Applications

In Lab-on-a-Chip devices syringes are used for the impulsion of gases or fluids. Main aspects are e.g., the precise positioning of small fluid quantities as well as the application of constant flow at low rates. Syringe pumps are also used for microreaction technology, where high precision dosing of milli- to nanoliter droplets is often crucial. Furthermore, the focus is often on the reproducibility for multiple-move operations, as required for dilution series or for complex processes composed of numerous individual pump steps.

Instrument Setup

Within a stand-alone device one or more syringe pumps can be integrated. A compact threefold syringe-module is shown in Fig. 1. Each syringe can be driven independently.

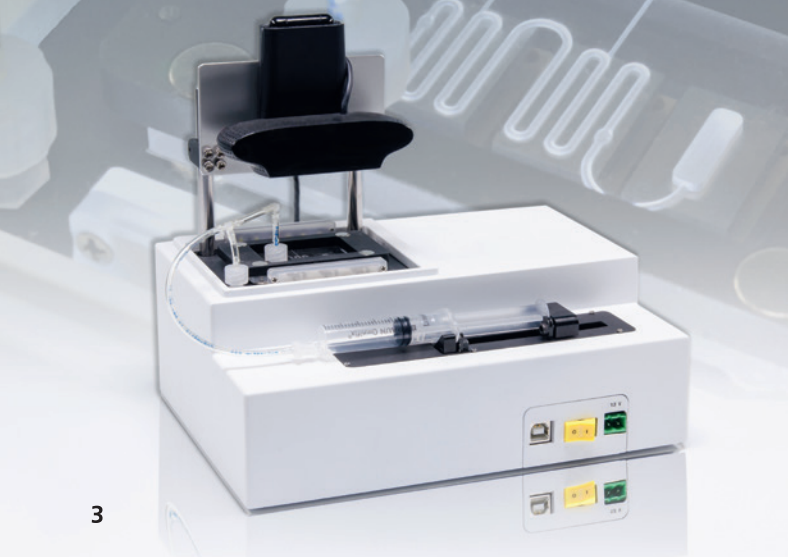
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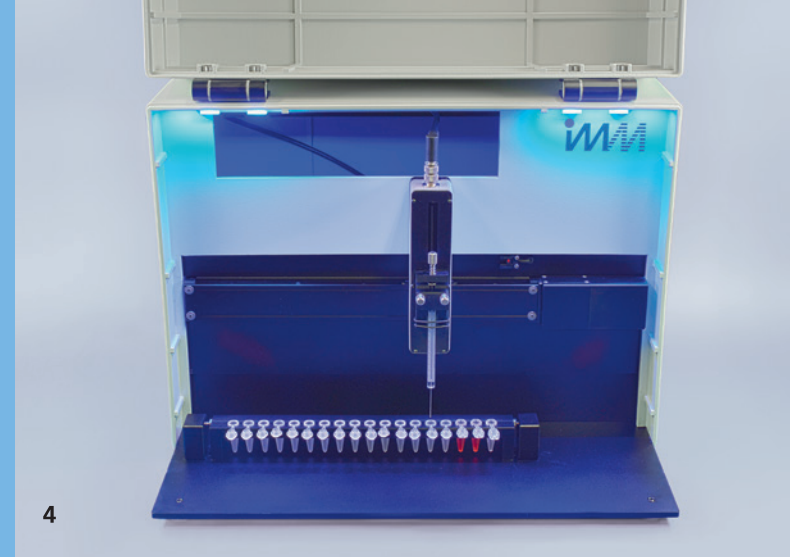
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The control electronics is already integrated into the device and the software can be adapted to the customer's requirements. Another threefold module can be seen in Fig. 2. This cabinet has been developed with focus on chemical resistance and leak tightness with respect to the liquid chemicals used. Besides such externally PC controlled devices, autonomously working devices with integrated user interfaces, like a touchscreen display, are also feasible.

Flexibility

Due to the wide selection of applicable syringes, Fraunhofer IMM has developed a modular system with different mounts for different types of syringes. If it comes to the choice of syringes, we aim for the biggest possible flexibility. Through this modular design, the pumps can easily be adapted to different applications by simply changing the mounts.

Integration

Fraunhofer IMM's syringe pumps are especially suited for integration within complex experimental setups. Therefore, OEM modules are available for a simple and space saving integration. The OEM-syringe module for fluidic actuation as shown in Fig. 3 allows for performing ultrafast PCRs within the "moving plug PCR device". In this process, the fluid is positioned over two heating zones on the chip with a counter pressure of 3 bar and a plug velocity of 20 mm/sec in the

channel. A high reproducibility is essential because up to 60–100 pump cycles are required for a PCR run. Thus, to further enhance reliability the pump is combined with a fluid detection sensor. Another example for integration of a syringe pump is the device for automated highly precise serial dilution (Fig. 4). We have achieved a dosing accuracy of $\pm 0.5 \mu\text{l}$ (at a dispensed volume of 5 μl).

Custom devices

We adjust syringe pumps to the requirements demanded by a specific problem. Number and size of syringes can be adapted as well as other parameters like maximum pressure, precision, power supply, etc. All OEM modules are delivered with an appropriate program code for easy integration into the customer's control software. Ready-to-use libraries in Labview, C/C++, etc., can be provided as well as components for programmable controllers.

For hardware control there is a modular IMM "electronic construction kit" with various components available, especially suitable for quickstart development purposes. In addition, specially adapted hardware with nearly all possible high and low level interfaces can be offered. Based on the experience made in the course of many successfully completed R&D projects, Fraunhofer IMM is your competent partner for the development of complete control systems for customer specific modules or integrated devices as well as for experimental setups.

Technical Data

Generally we are developing syringe pump modules based on our customers' specifications, not being limited to the specifications given in this table.

Exemplary specifications of the above presented instruments

Dosing accuracy:	$\pm 0,5 \mu\text{l}$
Max. pressure:	6 bar
Max. stroke:	60 mm
Supply voltage:	9-32 V
Interface:	serial, USB
Program code:	Labview, C/C++

3 OEM syringe module for ultrafast PCR.

4 Device for automated 16-fold serial dilution.