

# Semiconductors In Medical Electronics October 2020

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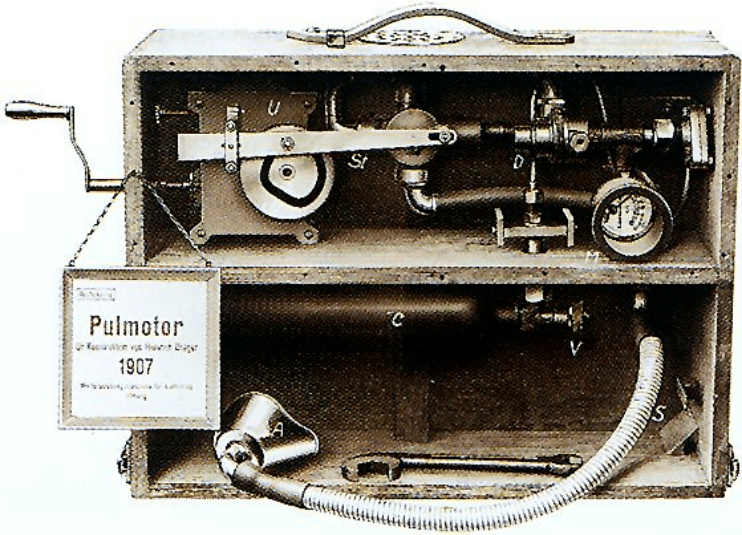
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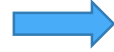
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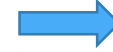
# Medical Devices Have A Long History.....



Pulmotor (1907)



Bennett PR-2 (1963)



Puritan-Bennett 840 (2001)

# .... And Semiconductors Are At The Heart Of Today's Equipment

Example: The Puritan Bennett™ 840 ventilator features 6 printed circuit boards, plus a power supply and battery backup board (not shown)

- ① Communications board
- ② User interface board
- ③ Pressure solenoid board
- ④ Controller board
- ⑤ Backup alarm driver board
- ⑥ LCD board

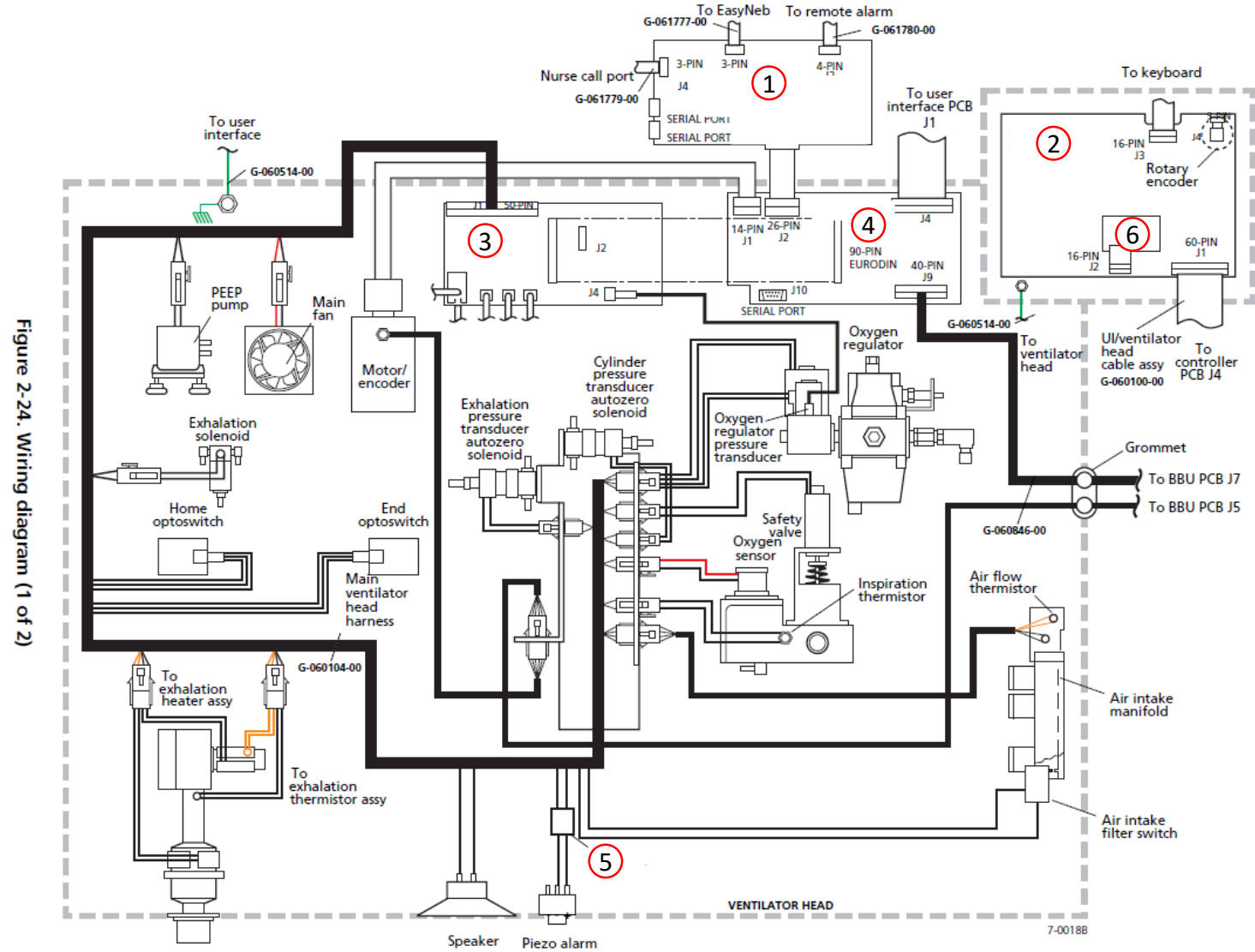


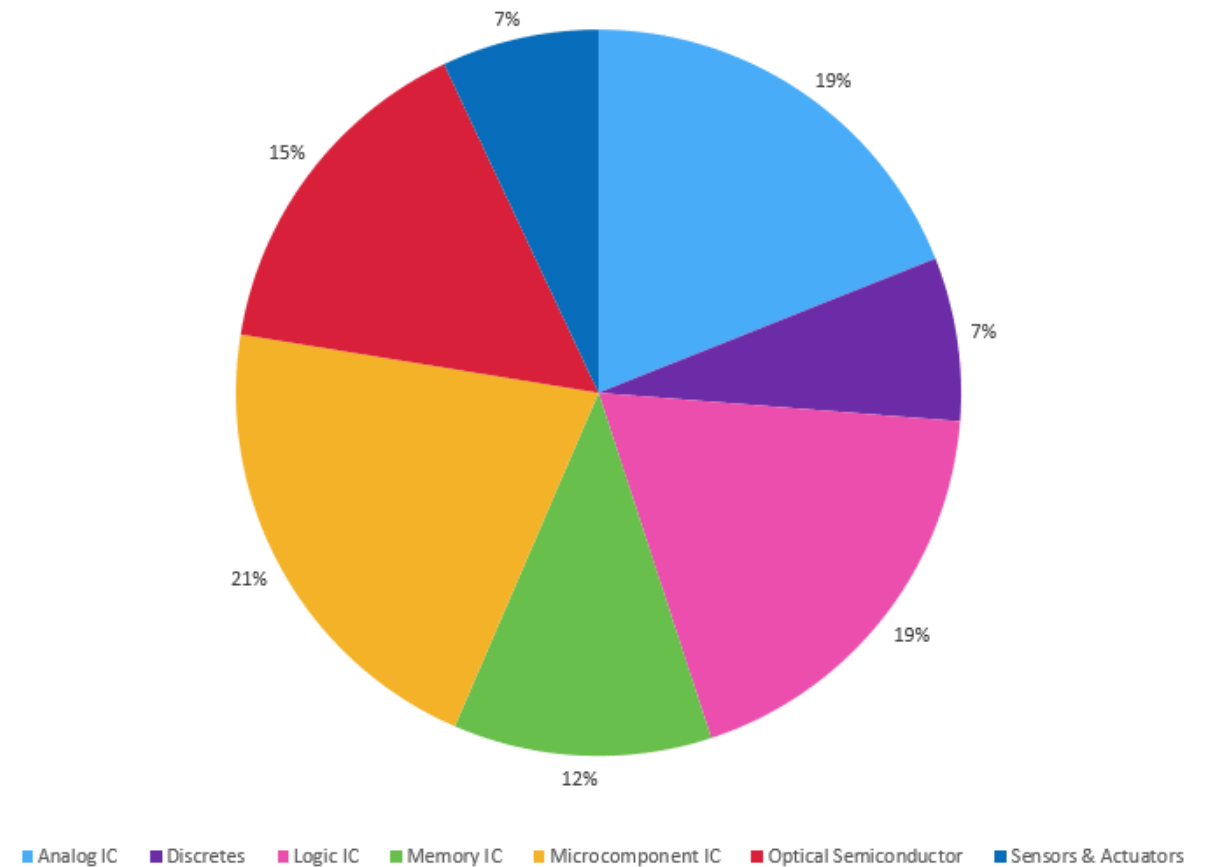
Figure 2-24. Wiring diagram (1 of 2)

# Medical Semiconductor Categories

- **Analog** – op amps, VREF, VREG, data converters, interface, analog ASICs
- **Discretes** – small-signal & power BJTs, FETs, IGBTs, rectifiers & diodes, RF/microwave, thyristors, etc.
- **Logic IC** – general-purpose logic, display drivers, FPGAs, logic ASICs
- **Memory** – DRAM, Flash, EEPROM, etc.
- **Microcomponent** – MPUs, MCUs, DSPs, etc.
- **Optical** – image sensors (CCD, CMOS), LEDs, lasers, laser diodes
- **Sensors & Actuators** – photodetectors, MEMS devices

Total Medical Semiconductor Revenue 2019: \$5.1 billion

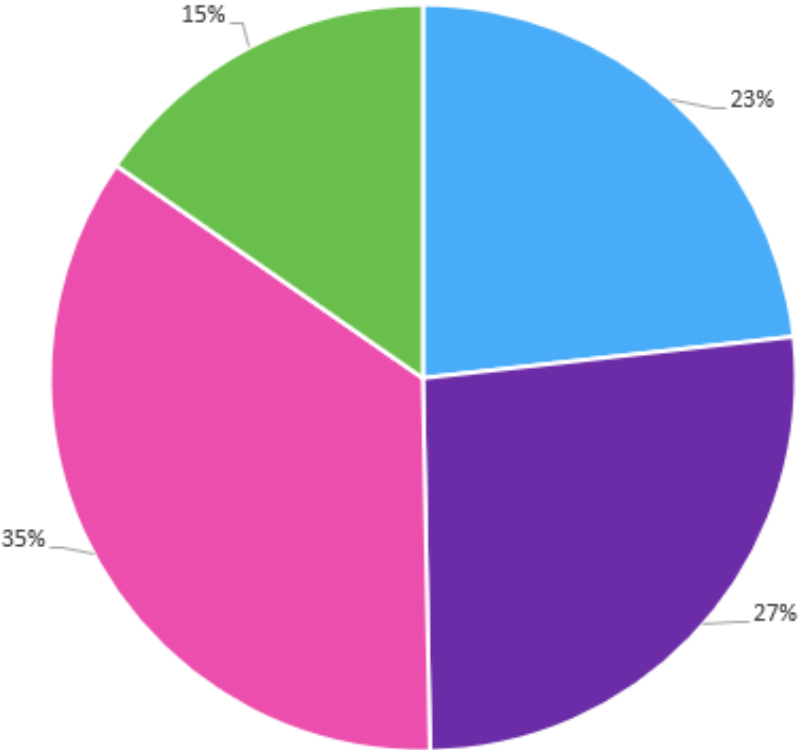
Semiconductor Share By Category 2019



# Medical Application Categories

- **Consumer** - Blood glucose meter, Blood pressure monitor, Cholesterol meter, Digital thermometer, Hearing aid, Pulse oximeter, TENS machine
- **Diagnostic, Patient Monitoring & Therapy** - Brain monitoring, CPAP, Dialysis machine, defibrillator, Nebulizers, Pacemaker, Patient monitoring, Ventilator,
- **Medical Imaging** - CT scan, MRI, Ultrasound, X-ray
- **Medical Instruments** – Endoscopy, miscellaneous

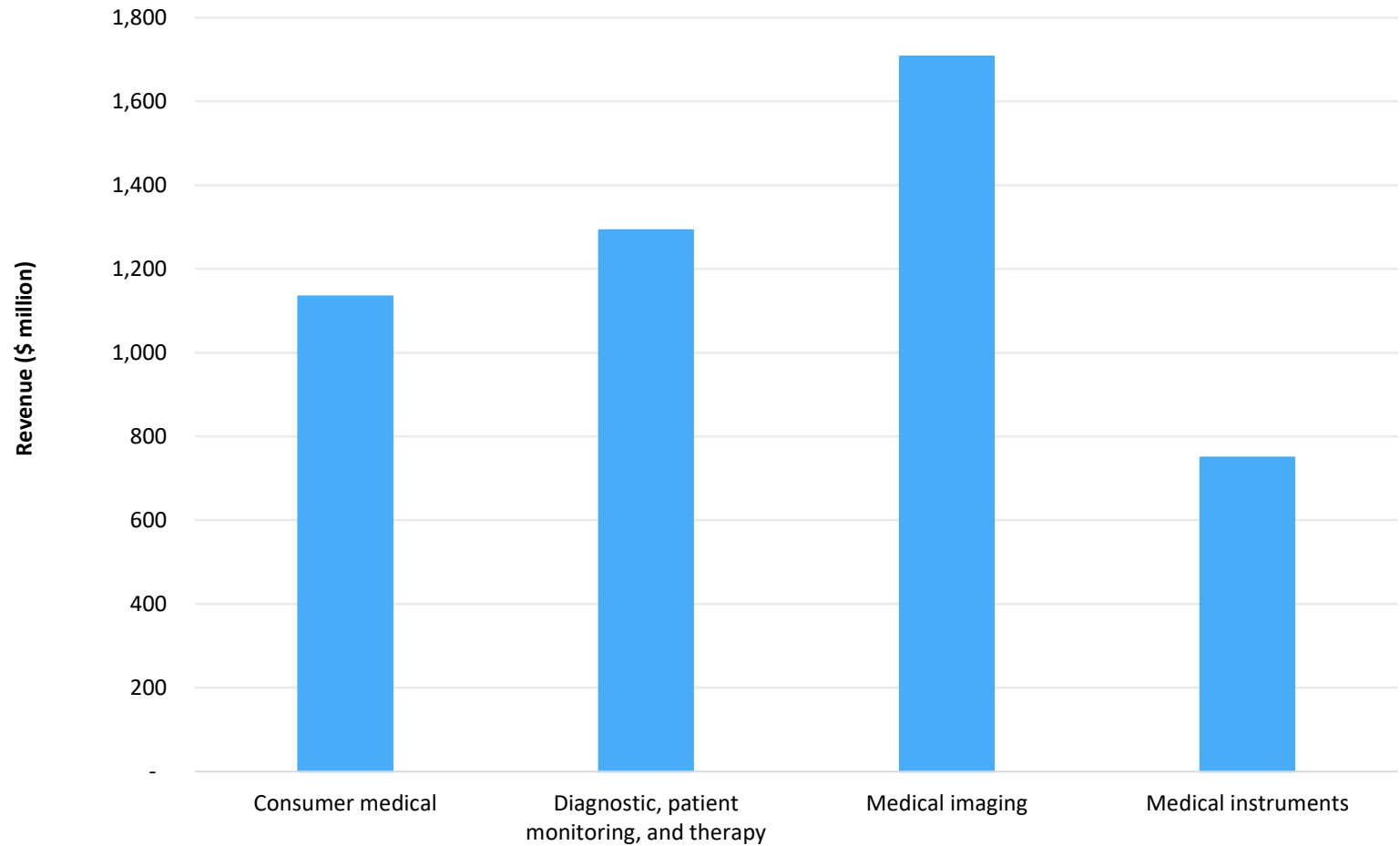
Medical Categories By Semiconductor Revenue 2019 (\$ M)



■ Consumer Medical   ■ Diagnostic, Patient Monitoring and Therapy   ■ Medical Imaging   ■ Medical Instruments

# Medical Semiconductors & COVID-19

- COVID-19 effects:
  - Increase in demand for treatment-related equipment (e.g., medical ventilators, patient-monitoring systems) and diagnostic equipment (e.g., digital X-rays, computerized tomography [CT] units).
  - Diversion of funds from non-COVID-19 segments (e.g., ultrasound and magnetic resonance imaging [MRI]).
  - Indirect effects include increase in telehealth as a result of the postponement or cancellation of routine appointments.
  - Many manufacturers are halting investment until the future becomes clearer



Source: Omdia

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# Long-Term Trends Are Positive For Medical Semiconductors

## Population demographics

- Aging in place
- Telehealth
- Replacement of older equipment
  - Newer equipment has increased semiconductor content
- Growth of AI
  - Clinical
  - Consumer
- Increase in portables and wearables
  - Low-power/high efficiency design
  - Smaller size -> increased integration
  - Wireless connectivity
- Addition of medical functions to consumer devices
  - Smart watches
  - Fitness bands

Medical Semiconductors YoY Growth

