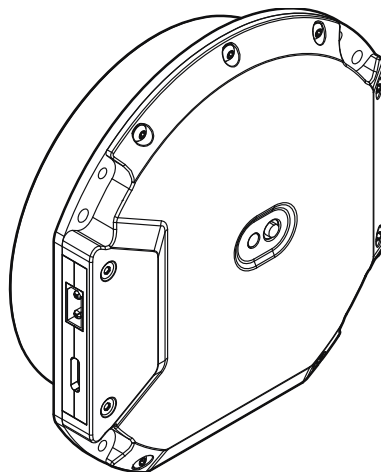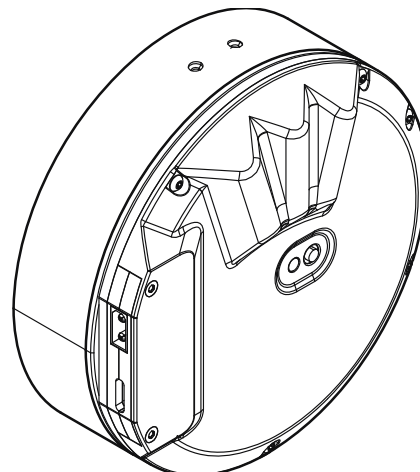# ActPack 4.1

CONFIGURATIONS

The ActPack is available in three configurations:

- **1:1 Direct Drive Actuator**
- **6:1 Geared Actuator**
- **9:1 Geared Actuator**

Direct Drive Actuator   Geared Actuator

KEY FEATURES

- Fully integrated brushless motor (BLDC), power electronics and control logic
- Plug-and-play solution: no programming needed for most applications
- Cross-platform graphical user interface (GUI) and full suite of C/C++, Python, and MATLAB demo scripts
- Built-in high-performance controllers: current, position, impedance, and voltage
- Built-in sensors and interfaces: 6-axis IMU, voltage, current, temperature, strain gauge amplifier, expansion port, etc.
- Communication: Bluetooth Classic EDR (BLE coming soon), USB, RS-485, SPI, UART, and I2C
- Safety features: battery I²t, motor I²t, voltage limits, temperature
- Designed to be compatible with the Open Source Leg (OSL) project

COMPLIANCE

- Contains FCC ID: QOQBT121 / Contains IC: 5123A-BGTBT121
- This device complies with Part 15 of the FCC Rules
- CAN ICES-003(B) / NMB-003(B)
-

SAFETY

- See dephy.com/safety

TABLE 1. MECHANICAL SPECIFICATIONS

	1:1	6:1	9:1
Mass	350 g	533 g	
Terminal Resistance	186 mΩ	210 mΩ	
Phase Resistance	279 mΩ	315 mΩ	
Motor Torque Constant	140 mNm/A	120 mNm/A	
Motor Voltage Constant	0.01 V/RPM	0.01 V/RPM	
L × W × H	94 mm × 99.5 mm × 28 mm	98 mm × 98 mm × 28 mm	
Material — Plate	6061-T6 Aluminum		
Material — Cover	6061-T6 Aluminum		

TABLE 2. EMBEDDED SYSTEMS SPECIFICATIONS

Power Connector	XT30 Connector
Voltage	20−50 V (5s-12s LiPo)
Commutation Type	4-Quadrant Field-Oriented Control (4Q FOC)
PWM Frequency	20 kHz
Max. Continuous Current	5 A[1]
Peak Motor Current	22 A[1]
High-Level Controller	STM32F777 216 MHz Cortex-M7 with Floating-Point Unit (FPU)
IMU	ICM-20602, 3-axis Gyroscope ±250 to ±2000DPS, 3-axis Accelerometer ±2g to ±16g
Bluetooth	BT121 Dual Mode Smart 4.1 Class 2 EDR (SPP, Virtual COM port)
USB	USB 2.0, USB-C connector, Virtual COM port
Strain-Gauge Amplifier	One Full-Bridge Channel, 5 V Excitation Gain = 203
Motor Encoder	Absolute Magnetic Encoder, 14-bits
Current Sensing & Control	Motor: 3-ch 12-bits sensing, 10kHz PI controller Battery: ±20 A, 900 Hz bandwidth, 12-bits
Safety Protections (HW)	52 V TVS, 15A Slow-Blow fuse
Safety Protections (SW)	Programmable fuses for battery and motor current, Programmable Under-Voltage Lockout (UVLO), 70°C shutdown
Intrinsic Sensors	Battery Voltage, Intermediate Voltage, +5 V Bus, Temperature, etc.
Connector — Encoder	I²C, RS-485 (half-duplex); Supports AK02 and Habsolute
Connector — Expansion	I²C, UART, SPI, Strain Gauge

[1] ActPack 0.2B and 4.1 are electrically the same, but 4.1 reports the Q-axis motor current which is 38% of the magnitude of the current reported by 0.2B, hence the different rating. This is also reflected by the increase in torque constant from 56 to 140 mNm/A.

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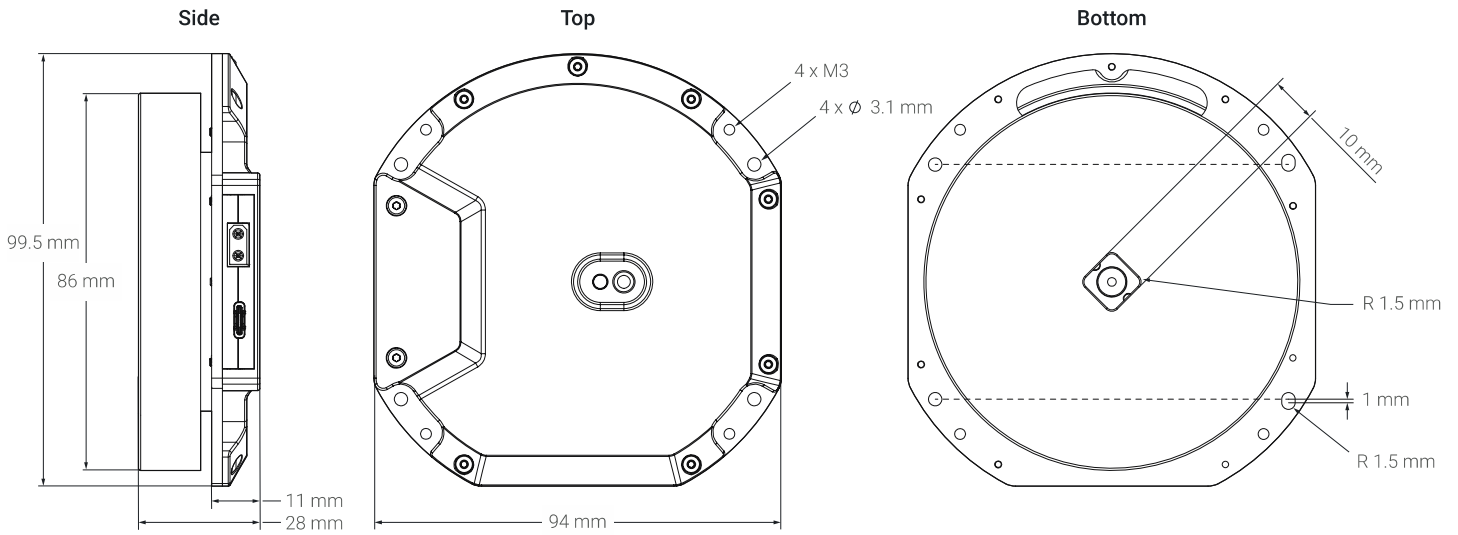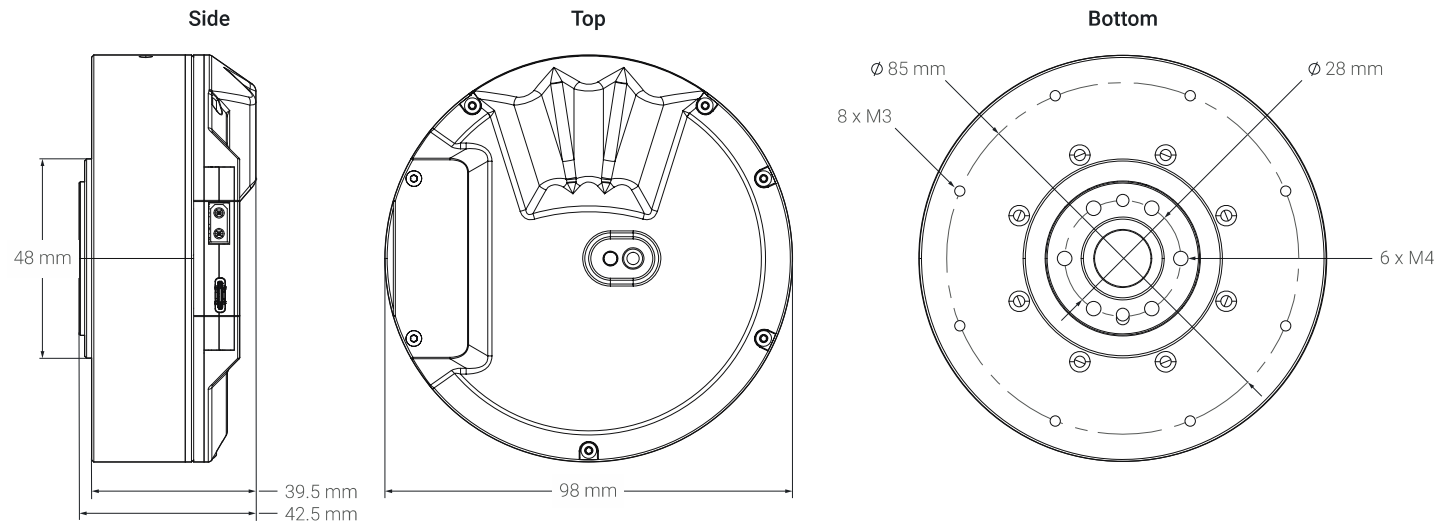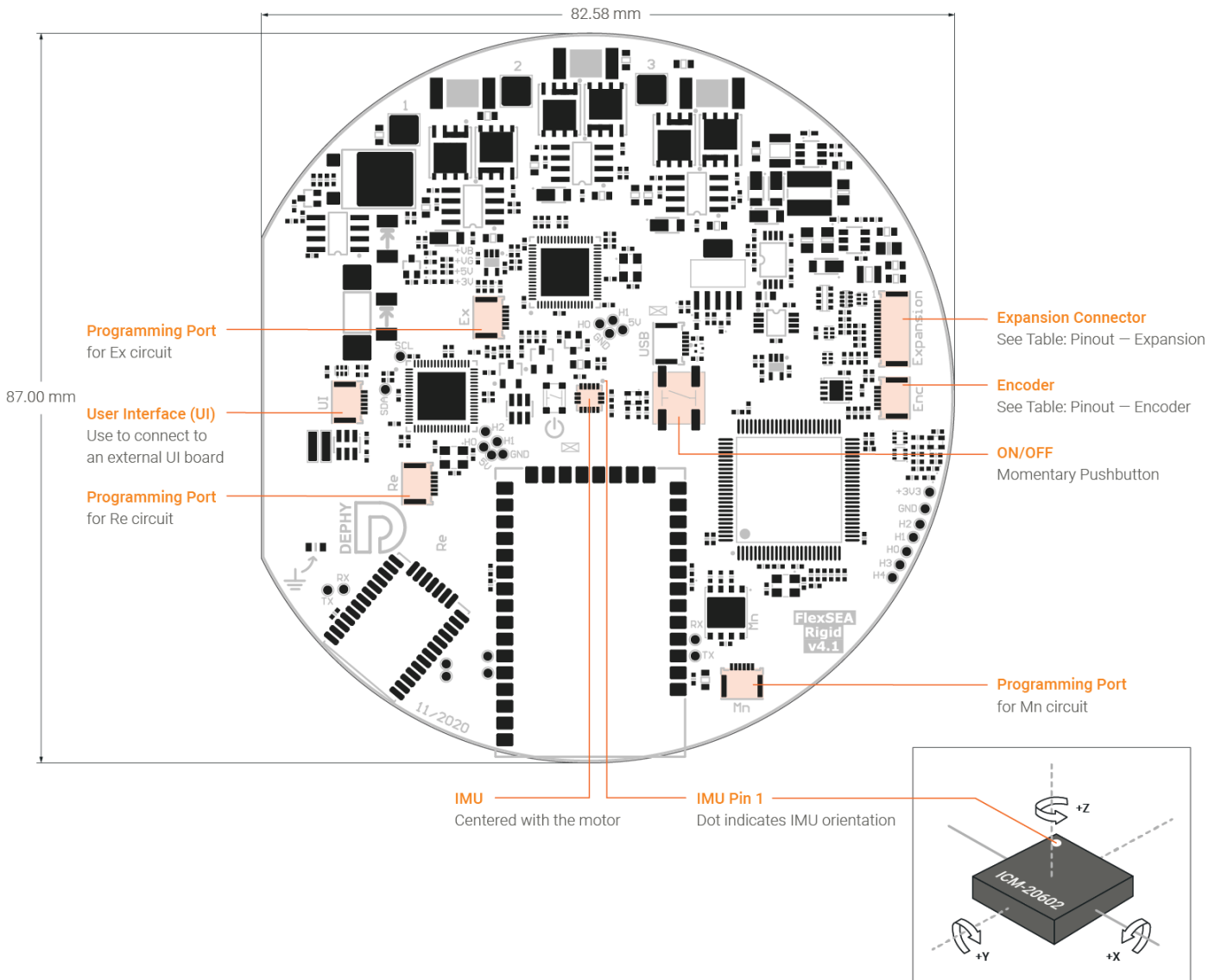## FIGURE 1. ACTPACK — DIRECT DRIVE ACTUATOR

Download STEP/STL

FIGURE 2. ACTPACK — GEARED ACTUATOR

Download STEP/STL

Note: 6:1 and 9:1 have the same physical dimensions

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FIGURE 3. CONNECTORS AND IMU

82.58 mm

87.00 mm

Programming Port
for Ex circuit

User Interface (UI)
Use to connect to
an external UI board

Programming Port
for Re circuit

Expansion Connector
See Table: Pinout — Expansion

Encoder
See Table: Pinout — Encoder

ON/OFF
Momentary Pushbutton

Programming Port
for Mn circuit

IMU
Centered with the motor

IMU Pin 1
Dot indicates IMU orientation

ICM-20602

+Z
+Y
+X

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EXPANSION & ENCODER CONNECTORS

- +5V, +3V3
- I²C, UART, SPI, RS-485
- Strain Gauge
- Can be used to connect the following:
    - Encoders (AK02, Habsolute)
    - 6-ch Strain Gauge amplifier (I²C)
    - External IMU
    - Strain gauge (bridge, not amplified)
    - Embedded computer
    - Sensors of your choice; firmware TBD.

Pinout — Expansion

Pin	Function	Pin	Function
1	+5V	8	SPI – MOSI
2	Strain Gauge, Positive Input	9	SPI – SCK
3	Strain Gauge, Negative Input	10	UART – RX
4	GND	11	UART – TX
5	+3V3	12	I2C – SDA
6	SPI – NSS	13	I2C – SCL
7	SPI – MISO	14	GND

Link to Altium files

Pinout — Encoder

Pin	Function	Pin	Function
1	+3V3	8	I²C – SDA
2	RS-485 – A	9	I²C – SCL
3	RS-485 – B	10	GND

Note: Same I²C on both connectors, pins are in parallel

ACCESSORIES

- **PSoC Programming:** Miniprog 3 or 4 with one of following:
    - Tag-Connect (TC2030-CTX-NL)
    - Dephy PSoC Prog Adapt FFC
- **STM32 Programming:** ST-Link v3 with one of the following
    - Tag-Connect (TC2030-CTX-NL-STDC14)
    - Dephy STM32 Prog Adapt FFC
- **USB Cable:**
    - Digikey #123-A-USB31C-20A-200A-ND
    - Amazon: B07CZQWNCK
- **Expansion Adapter**
- **Base plate**

Compliance

Supplier's Declaration of Conformity
47 CFR § 2.1077 Compliance Information

Unique Identifier: ActPack 4.1

Responsible Party – U.S. Contact Information

Dephy, Inc.
63 Great Road
Suite 204
Maynard, MA 01754
admin@dephy.com

FCC Compliance Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Industry Canada (IC)
This radio transmitter (IC: 5123A-BGTBT121) has been approved by Industry Canada to operate with the embedded chip antenna. Other antenna types are strictly prohibited for use with this device.

This device complies with Industry Canada's license-exempt RSS standards. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device

Industrie Canada (IC), Français
Cet émetteur radio (IC: 5123A-BGTBT121) a reçu l'approbation d'Industrie Canada pour une exploitation avec l'antenne puce incorporée. Il est strictement interdit d'utiliser d'autres types d'antenne avec cet appareil.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1) l'appareil ne doit pas produire de brouillage;
2) l'utilisateur de l'appareil doit accepter tout brouillage

Date	July 10, 2023
Revision	C_0003_DS_0001_V04_ACTDATA
Created by	Jared Coughlin
Reviewed by	Matt Mooney
Approved by	Matt Mooney
Purpose	Datasheet for the ActPack 4.1 that has been reviewed and approved for release

Jared Coughlin
Jared Coughlin (Jul 10, 2023 17:36 EDT)

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C_0003_DS_0001_V04_ACTDATA

Final Audit Report   2023-07-10

Created:	2023-07-10
By:	Matt Mooney (mmooney@dephy.com)
Status:	Signed
Transaction ID:	CBJCHBCAABAA0h7rRZcCRqWQ8Z7KNy61fKC96-J5hbt_

"C_0003_DS_0001_V04_ACTDATA" History

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