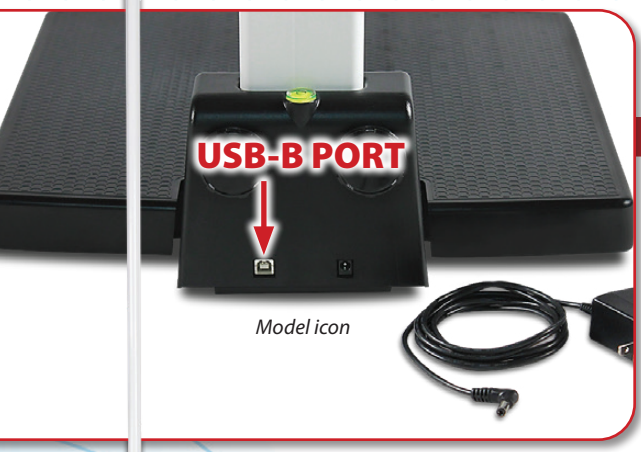
PERIPHERAL COMMUNICATION FOR icon + apex

DIGITAL CLINICAL SCALES

CLINICAL SCALES



Model icon

See inside for details about apex peripheral communication.

icon USB-B PORT

The icon's USB-B port is located on the scale base, and it may be connected to a USB device by an industry-standard "B" cable. It can be used for sending data to any compatible USB device. Height, weight, and BMI will automatically be sent with each locked weight. Also, there is a hidden port on the display that is only intended to be used by service personnel as a bootloader.

Model icon

icon Base USB

The icon's USB-B port located on the scale base allows selecting one of three modes in the scale setup.

- (1) PHDC – This is a widely implemented USB standard in the medical field. Any device that "understands" PHDC will be able to gather information from the icon in this mode.
  - USB device configured to send data to PHDC host per ISO 11073-10415
  - The following information is sent continuously at a rate of 2 times per second:
  - Time • Weight • Height • BMI
- (2) Welch-Allyn – This mode implements Welch-Allyn's custom protocol (WACP) for sending data to many Welch-Allyn monitors. Height, weight, and BMI will automatically be sent with each locked weight.
  - USB device configured for Welch-Allyn communication using the WACP protocol.
  - The following WACP packets are sent for each new height/weight (upon locking):
  - FmERR OR_GnSTATUS_ERROR_CSS_SpREPORT_ERROR Note: Errors include over capacity, analog high, and analog low
  - FmWEIGHT_GnSTATUS_WEIGHT_CSS_SpREPORT_ WEIGHT
  - FmHEIGHT_GnSTATUS_HEIGHT_CSS_SpREPORT_HEIGHT
  - FmBODYMASSINDEX_GnSTATUS_BODYMASSINDEX_ CSS_SpREPORT_BMI
- (3) SMA – A plain ASCII protocol that is easy to interface with.
  - SMA commands are of the form <LF><CMD><CR> where <CMD> may be single or multi-character. Command list:
  - Use the <CMD> and <RESPONSE> table from the apex USB PORT section on page 3 of this bulletin.

icon Display USB

The display's USB port is inaccessible to the end-user. Its only function is for providing a bootloader interface for maintenance purposes.

icon BLE / WI-FI

The icon® Digital Clinical Scale has a wireless transmitter inside the case of the display. It can be configured for Bluetooth 5.0 (BLE) or Wi-Fi. Widely accept BLE GATT standard specification profiles are used (those that are adopted by the Bluetooth SIG) to transmit vitals to other devices/software that have implemented these profiles. For both BLE and Wi-Fi, custom services were created to request indicator and scale information whose communication protocol was developed by the Scale Manufacturers Association (SMA). For a complete listing of the SMA commands, refer to the Apex and Icon RS232, BLE, and Wi-Fi SMA Commands on page 5.

icon BLUETOOTH LOW ENERGY (BLE)

Data is passed via BLE using GATT characteristic "Weight_ Measurement" (0x2A9D). See page 6 for the data table about the Weight Measurement Characteristics.

Data includes:

- Weight
- Date/Time
- ID
- BMI
- Height

icon WI-FI

If the wireless module is configured for Wi-Fi instead of BLE, the scale will transmit data using communication protocols developed by the Scale Manufacturers Association (SMA).

To transmit a single set of weight data, the SMA weight request <LF>W<CR> should be sent to the scale. If continuously transmitted weight data is required, the SMA weight request <LF>R<CR> should be sent to the scale. Note that the scale will transmit weight data continually until another SMA command is received.

The SMA format for both commands (<LF>W<CR> and <LF>R<CR>) is:

<RESPONSE>
<LF><s><r><n><m><f><xxxxxx.xxx><uuu><CR>

<CMD>	<RESPONSE>	
LF	Line feed (hex 0A) = Start of response message	
s	Scale Status definition	
	Z	Center of Zero <xxxxxx.xxx>= 0.000
	O	Over Capacity <xxxxxx.xxx>= +weight
	U	Under Capacity <xxxxxx.xxx>= -weight
	E	Zero Error (clears when the condition clears)
	<space>	None of the above conditions NOTE: For "E" error condition <xxxxxx.xxx>= ——————— (center dashes) and "Z", "O", "U" is overridden
r	Range ("1", "2", "3", etc.) always "1" for a single range	
n	Mode of Operation (Gross/Net status)	
	G	Gross normal weight
	T	Tare weight (in response to "M" command)
	N	Net normal weight
	g	Gross weight in high-resolution
	n	Net weight in high-resolution
M	Motion status	
	M	Scale in Motion
	<space>	Scale not in Motion
f	Future = Reserved for future or custom use	
xxxxxx.xxx	Weight with a decimal point if necessary	
uuu	Units = e. g. lb, kg	
CR	Carriage Return (hex 0D) = End of response message	

apex USB PORT

The apex's USB port is located on the back of the apex display. It is accessible by a USB-B micro. In the setup menu, one of three modes may be selected:

(1) PHDC – This is a widely implemented USB standard in the medical field. Any device that "understands" PHDC will be able to gather information from the apex in this mode.

- USB device configured to send data to PHDC host per ISO 11073-10415
- The following information is sent continuously at a rate of 2 times per second:
  - Time
  - Weight
  - Height
  - BMI

(2) Welch Allyn – This mode implements Welch-Allyn's custom protocol (WACP) for sending data to many Welch-Allyn monitors. Height, weight, and BMI will automatically be sent with each locked weight.

- USB device configured for Welch-Allyn communication using the WACP protocol. The following WACP packets are sent for each new height/weight (upon locking):
  - FmERROR_GnSTATUS_ERROR_CSS_SpREPORT_ERROR
    Note: Errors include over capacity, analog high, and analog low
  - FmWEIGHT_GnSTATUS_WEIGHT_CSS_SpREPORT_WEIGHT
  - FmHEIGHT_GnSTATUS_HEIGHT_CSS_SpREPORT_HEIGHT
  - FmBODYMASSINDEX_GnSTATUS_BODYMASSINDEX_CSS_SpREPORT_BMI

(3) SMA – A plain ASCII protocol that is easy to interface with.

SMA commands are of the form <LF><CMD><CR> where <CMD> may be single or multi-character. Command list:

<CMD>	<RESPONSE>		
W	<LF><S>1G<M><SPACE>XXXXXXXX.X <UUU><CR>		
	<LF>	Line Feed Character	
	<S>	Scale Status	
		'Z'	Center Zero
		'U'	Below Zero
		'O'	Over Capacity
		Blank	No Special Status to Indicate
	<M>	Motion	
		'M'	Motion
		Blank	Stable
	XXXXXXXX.X	Gross Weight	
	<UUU>	Units String	
	<CR>	Carriage Return Character	
P	<date>	Date	
	<time>	Time	
	<weight with unit>	Weight	
	<height with unit>	Height	
	<bmi>	BMI	
Z	Zero Scale – No Response		
U	Toggle Units – No Response		
Invalid	<LF>?<CR>		

apex RS232 COM PORTS

The apex display has one wired serial port on the back of the display. This port may be used to request and capture weight, send basic commands, or get diagnostics from the load cell. To use the port, an apex to PC serial cable can be purchased from the Cardinal / Detecto Parts Department at (800) 641-2045 or parts@cardet.com. The part number is 3300-0271-0A, APEX TO PC SERIAL CABLE.

apex BLE / WI-FI

Wireless apex models will have a wireless transmitter inside the case of the apex display. It can be configured for Bluetooth Low Energy (BLE) or Wi-Fi. Widely accept BLE GATT standard specification profiles are used (those that are adopted by the Bluetooth SIG) to transmit vitals to other devices/software that have implemented these profiles. For both BLE and Wi-Fi, custom services were created to request indicator and scale information whose communication protocol was developed by the Scale Manufacturers Association (SMA). For a complete listing of the SMA commands, refer to the Apex and Icon RS232, BLE, and Wi-Fi SMA Commands on page 5.

apex WI-FI

If the wireless module is configured for Wi-Fi instead of BLE, the scale will transmit data using communication protocols developed by the Scale Manufacturers Association (SMA).

To transmit a single set of weight data, the SMA weight request <LF>W<CR> should be sent to the scale. If continuously transmitted weight data is required, the SMA weight request <LF>R<CR> should be sent to the scale. Note that the scale will transmit weight data continually until another SMA command is received.

The SMA format for both commands (<LF>W<CR> and <LF>R<CR>) is:

<LF><s><r><n><m><f><xxxxxx.xxx><uuu><CR>

See "apex" and "icon" SMA Weight Response Table on page 5 for a breakdown of the response format.

apex BLUETOOTH LOW ENERGY (BLE)

Data is passed via BLE using GATT characteristic "Weight_Measurement" (0x2A9D). See page 6 for the data table about the Weight Measurement Characteristics.

Data includes:

- Weight • Date/Time • ID • BMI • Height

apex and icon Additional Bluetooth Services

Note: 16-bit (4-digit) UUID's are adopted standards. 128-bit (32 digit) UUID's are custom services or characteristics.

Standard Services per Bluetooth SIG

Reference adopted specifications at https://www.bluetooth.com/specifications/gatt

Device Information Service (0x180A)

CHARACTERISTICS	Number	Value(s)	Attributes
Manufacturer Name String	0x2A29	"Detecto"	READ
Model Number String	0x2A24	"Apex-C" or "Icon"	READ
Software Revision String	0x2A28	"1.0.XX" software of scale	READ

Battery Service (0x180F)

CHARACTERISTICS	Number	Value(s)	Attributes
Battery Level	0x180F	0x00 – 0x64 (uint16), represents 0 – 100 percent	READ

Weight Scale Service (0x181D)

CHARACTERISTICS	Number	Value(s)	Attributes
Weight Measurement	0x2A9D	<8bit Flag> <uint16 weight> <uint16 bmi> <uint16 ht>	READ INDICATE
		Supported Flags:	
		bit0: 0	SI
		bit0: 1	Imperial
		bit3: 0	BMI and Height not present
		bit3: 1	BMI and Height present
		bit4: 0	Not below zero*
		bit4: 1	Below zero*
		SI:	
		Wt	KG with resolution 0.0005
		Ht	meters with resolution 0.001
		Imperial:	
		Wt	lbs with resolution 0.01
		Ht	inches with resolution 0.1
Weight Scale Feature	0x2A9E	NOT YET IMPLEMENTED	

* If the weight is below zero (0), the weight you will see is zero (0).

* If the weight is below zero (0), bit 4 of Weight Measurement will be set to 1, otherwise, bit 4 is set to zero (0).

NOTE: Maximum weight value displayed is 655.35 in both pounds (lb) and kilograms (kg).

apex and icon RS232, BLE, and Wi-Fi SMA Commands

The format used to send SMA commands to the apex and icon scale is:

<LF>command<CR>

Where "command" is the ASCII letter(s), or the Hex Rep. listed in the table below. For example, <LF>Z<CR> or 0A5A0D would send the command to zero the scale. Note that the response of each command is listed under the Response column of the table.

NOTE: Any invalid command sent will return a question mark for a response. For example, sending a <LF>XZ<CR> will return 0A 3F 0D (<LF>?<CR>).

COMMAND	HEX REP.	HEX RESPONSE	RESPONSE
Z - Zero Scale	0A5A0D	None.	You should see scale zero itself.
D – Scale Diagnostics	0A440D	0A 20 20 20 20 0D	Means there are no errors, EEPROM error will show an E in the second space and C will show in the third space if there is a calibration error.
		20	SPACE
W – Request Weight	0A570D	0A 5A 31 47 20 20 30 30 30 30 30 30 2E 30 30 6C 62 0D	Z1G 000000.00lb
H – Request High Resolution Weight	0A480D	0A 5A 31 67 20 20 30 30 30 30 30 30 2E 30 31 6C 62 0D	Z1g 000000.01lb
A – About Scale First Line	0A410D	0A 53 4D 41 3A 32 2F 31 2E 31 0D	SMA:2/1.1
B – About Scale Scroll	0A420D	Each time sent you will get the next line of information until there is no longer any information.	
		1. 0A 4D 46 47 3A 44 65 74 65 63 74 6F 0D	MFG:Detecto
		2. 0A 4D 46 44 3A 41 70 65 78 0D	MOD:Icon or Apex-C
		3. 0A 52 45 56 3A 31 2E 30 2E 31 34 0D	REV:X.X.XX
		5. 0A 45 4E 44 3A 0D	END
		6. If B is sent again you will get the unknown command response until the A command is sent again. 0A 3F 0D	?
N – Scale Information Scroll	0A4E0D	Each time sent you will get the next line of scale information until there is no longer any information.	
		1. 0A 54 59 50 3A 53 0D	TYP:S
		2. 0A 43 41 50 3A 20 6C 62 3A 36 30 30 2E 30 3A 32 3A 31 0D	CAP: lb:600.0:2:1, this depends on the settings of the scale. 600.0 – Capacity, 2 – Interval, & 1 – Decimal
		3. 0A 43 4D 44 3A 48 52 49 4E 58 0D	CMD:HRINX
		4. 0A 45 4E 44 3A 0D	END
		5. If N is sent again you will get the unknown command response until the I command is sent again. 0A 3F 0D	?
R – Repeat Displayed Weight Continuously	0A520D	0A 5A 31 47 20 20 30 30 30 30 30 30 2E 30 30 6C 62 0D	Z1G 000000.00lb, you should get this continuously until another SMA command is received.
XB – Battery Level Percentage	0A58420D	0A 38 36 2E 32 35 0D	86.25

apex and Icon SMA Weight Response Table

LF	Line feed (hex 0A) =	Start of response message
s	Scale Status Definition	
	Z	Center of Zero <xxxxxx.xxx>= 0.000
	O	Over Capacity <xxxxxx.xxx>= +weight
	U	Under Capacity <xxxxxx.xxx>= -weight
	E	Zero Error (clears when the condition clears)
	<space>	None of the above conditions
	NOTE: For "E" error condition <xxxxxx.xxx>	
	———————	(center dashes) and "Z", "O", "U" is overridden
r	Range ("1", "2", "3", etc.) always "1" for a single range	
n	Mode of Operation (Gross/Net status)	
	G	Gross normal weight
	T	Tare weight (in response to "M" command)
	N	Net normal weight
	g	gross weight in high-resolution
	n	net weight in high-resolution
m	Motion status	
	M	Scale in Motion
	<space>	Scale not in Motion
f	Future	Reserved for future or custom use
xxxxxx.xxx	Weight with a decimal point if necessary	
uuu	Units	e. g. lb, kg
CR	Carriage Return (hex 0D)	End of response message

Bluetooth Characteristic – Weight_Measurement: 0x2A9D

NAMES	FIELD REQUIREMENTS	FORMAT	MIN. VALUE	MAX. VALUE	ADDITIONAL INFORMATION
Flags	Mandatory	8 bit	N/A	N/A	**BIT FIELD**

BIT FIELD

Bit	Size	Name	Definition		
			Key	Value	Requires
0	1	Measurement Units	0	SI (Weight and Mass in Units of Kilogram (kg) and Height in Units of Meter)	CI
			1	Imperial (Weight and Mass in Units of Pound (lb) and Height in Units of inch (in))	C2
1	1	Time Stamp Present	0	False	
			1	True	C3
2	1	User ID Present	0	False	
			1	True	C4
3	1	BMI and Height Present	0	False	
			1	True	C5
4	1	Below Zero	0	Not Below Zero	
			1	Below Zero	

NAMES	FIELD REQUIREMENTS	FORMAT	MIN. VALUE	MAX. VALUE	ADDITIONAL INFORMATION
Weight - SI	C1	uint16	N/A	N/A	**Information:** Unit is in kilograms with a resolution of 0.005 and is determined when bit 0 of the Flags field is set to 0. **Unit:** org.bluetooth.unit.mass.kilogram **Exponent:** Decimal, -3 **Multiplier:** 5
Weight - Imperial	C2	uint16	N/A	N/A	**Information:** Unit is in pounds with a resolution of 0.01 and is determined when bit 0 of the Flags field is set to 1. **Unit:** org.bluetooth.unit.mass.pound **Exponent:** Decimal, 02.
Time Stamp	C3		N/A	N/A	**Information:** Smallest unit in seconds **Unit:** org.bluetooth.characteristic.date.time
User ID	C4	uint8	N/A	N/A	The special value of 0XFF (255 Decimal) for User ID represents "unknown user". **Information:** Unit is unitless with a resolution of 1

Key	Value
255	Unknown user

					Unit: org.bluetooth.unit.unitless **Exponent:** Decimal, 0
BMI	C5	uint16	N/A	N/A	**Information:** Unit is unitless with a resolution of 0.1 **Unit:** org.bluetooth.unit.unitless **Exponent:** Decimal, -1
Height - SI	C1 C5	uint16	N/A	N/A	**Information:** Unit is in meters with a resolution of 0.001 and is determined when bit 0 of the Flags field is set to 0. **Unit:** org.bluetooth.unit.length.meter **Exponent:** Decimal, -3
Height - Imperial	C2 C5	uint16	N/A	N/A	**Information:** Unit is in inches with a resolution of 0.1 and is determined when bit 0 of the Flags field is set to 1. **Unit:** org.bluetooth.unit.length.inch **Exponent:** Decimal, 0-1

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