PHILIPS

Application note

Q-CPR® measurement and feedback with Q-CPR Meter® 2

Introduction

Consider the following:

- The quality of cardiopulmonary resuscitation (CPR) has a direct effect on survival rate and patient outcomes from cardiac arrest.[1-4]
- Caregivers, on the whole, often do not perform CPR within established guidelines associated with compression rate, depth, and complete release, as well as with no compression activity (or “hands-off ” time), and ventilation rate.[5-8]
- The American Heart Association (AHA) recognizes the importance of real-time feedback on improving CPR performance, such that devices that measure CPR performance are required in all CPR training as of 2019.[9]

These statements directly relate to the need to measure and obtain feedback during CPR. The HeartStart Intrepid Q-CPR function with Q-CPR Meter 2 by Philips represents one method and is the focus of this application note.

Q-CPR®: The measurement and feedback solution

Cardiopulmonary Resuscitation (CPR) is a combination of chest compressions and ventilations delivered to victims in cardiac arrest. The Q-CPR® option offers real-time measurement and corrective feedback on the rate, depth, and complete release of compressions, ventilation rate, and lack of CPR activity in accordance with current CPR guidelines. The feedback can appear on the HeartStart Intrepid display and on the Q-CPR Meter 2 display (compression feedback only)..

The Q-CPR function on the Philips HeartStart Intrepid in conjunction with the Q-CPR Meter 2 provides real-time audio and visual feedback on compression depth and rate as well as ventilation rate on adults (over 8 years of age or weighing more than 25 kilograms/55 lbs.) in accordance with International Liaison Committee on Resuscitation (ILCOR) guidelines.[10] Q-CPR is available in Manual Mode, AED Mode, and Pacer Mode (Fixed only).

HeartStart Intrepid with Q-CPR

Feedback for the Q-CPR function of the HeartStart Intrepid is measured using the Q-CPR Meter 2 connected to the HeartStart Intrepid and Philips multifunction defibrillation electrode pads (Figure 1). Compression data is acquired through the Q-CPR Meter 2, and ventilation data is acquired through Philips multifunction defibrillation electrode pads. Visual indicators and audio prompts provide feedback to the rescuer when CPR performance deviates outside of target ranges.

The multifunction pads are placed on the patient's chest in the Anterior-lateral pad position, and the Q-CPR meter is applied to the center of the patient's chest (Figure 2 and Figure 3). During use, the Q-CPR meter measures chest compression depth and rate while a ventilation algorithm analyzes chest impedance measured from the multifunction pads to produce a ventilation rate.

Figure 2:
Anterior-lateral pad position.

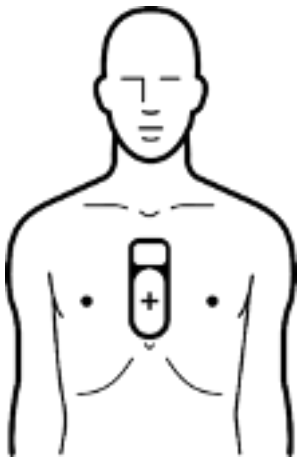


Figure 3:
Q-CPR meter placement.

Figure 1: HeartStart Intrepid with Q-CPR.

CPR compression depth guidelines

WARNING: When performing CPR on a patient lying on a surface that yields, do not use the Q-CPR meter if a backboard is not in place.

On the HeartStart Intrepid, compression depth is presented as a waveform in wave sector 2 (labeled 'Comp') and represents about 10 seconds of compressions, as derived from signals from the Q-CPR Meter 2 (Figure 4). As the chest is compressed, the compression is represented as a downward stroke of the wave, rebounding up to a baseline as compression pressure is released.

The HeartStart Intrepid displays two horizontal lines in the wave sector drawn at 50mm/1.5" and 60 mm/2" to indicate the target zone needed to achieve effective compression depth.

Compression depth guidelines

Good compression depth is achieved when the peak, or minimum value, of the waveform appears between the lines. When pressure is not released between compressions, an asterisk (*) will annotate the baseline segment between compressions. This is also referred to as "leaning." If the signal from the CPR meter becomes invalid (e.g., the meter is disconnected), the waveform appears as a dashed line. Compression measurement value is printed in the annotation area of the ECG printed strip.

NOTE: If the Pads/CPR cable is not connected when you turn the Therapy Knob to AED Mode, the message Connect Pads Cable is displayed.

A calculated compressions-per-minute (cpm) rate is displayed to the right of the compression wave (Figure 4). If compression depth or rate deviate significantly from AHA/ERC guidelines, the monitor/defibrillator will provide corrective audible feedback in AED Mode by default and in Manual Mode if enabled. If there are no detectable compressions, a No CPR time value will count "hands off" seconds, starting at 2 seconds and incremented with each additional second (Figure 4).

Ventilations

The defibrillation pads collect ventilation data by detecting changes in thoracic impedance. The ventilation rate is presented as respirations-per-minute (rpm), like compression, if the ventilation rate falls outside the AHA/ERC guidelines, visual and audible feedback are given.

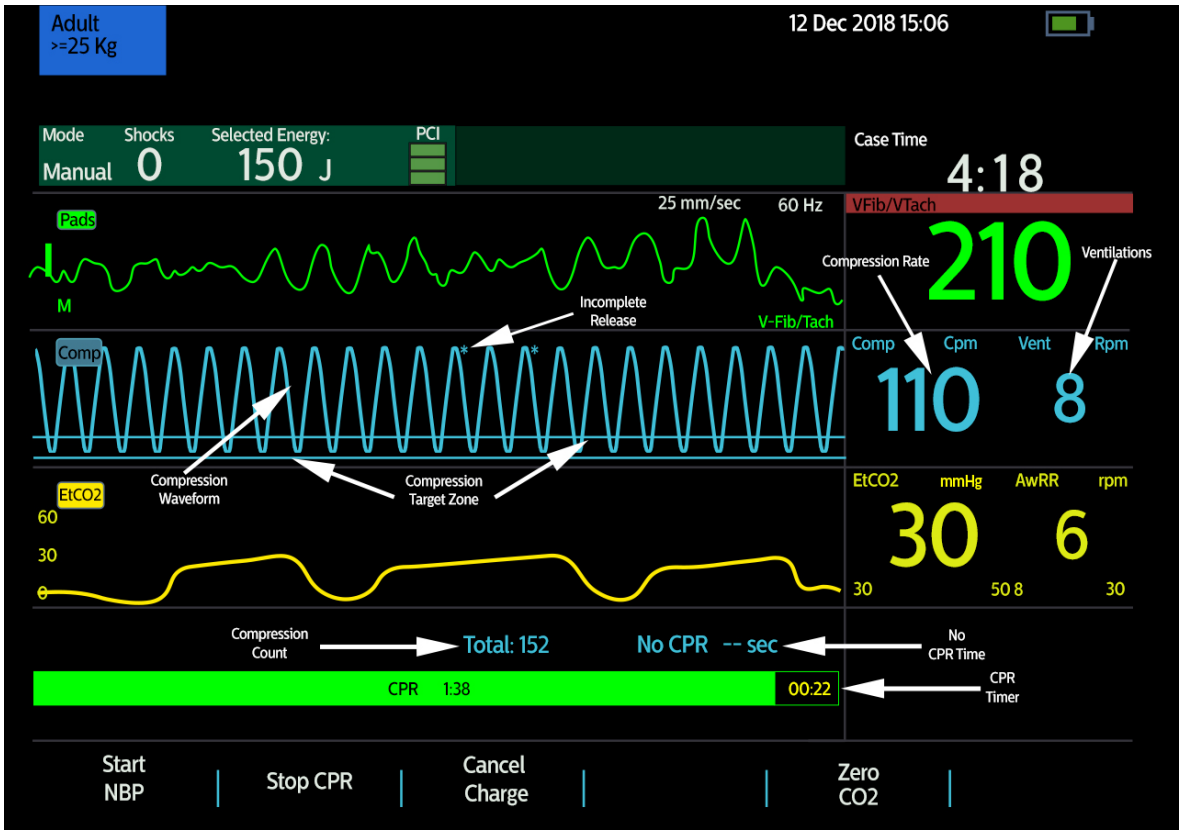


Figure 4: HeartStart Intrepid Q-CPR display.

Starting CPR with the CPR Meter 2

The Q-CPR Meter 2 provides real-time graphical feedback once CPR compressions begin. Using standard CPR technique, place the heel of one hand directly over the compression area of the attached Q-CPR Meter 2. Place the other hand on top of the first, interlocking fingers. Make sure the display area of the Q-CPR Meter 2 is visible to look for feedback (Figure 5). Provide chest compressions according to organizational CPR protocol.

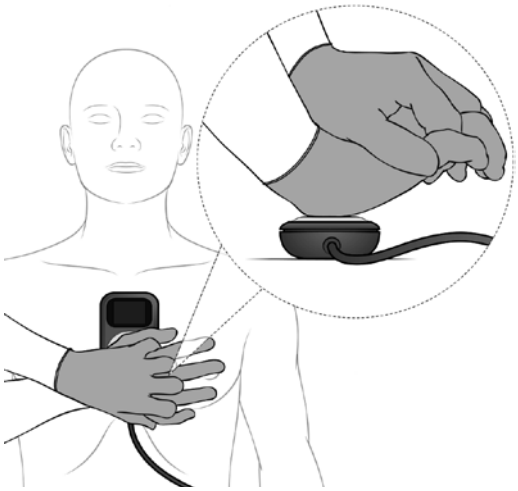


Figure 5: CPR Meter placement.

When the Q-CPR Meter 2 first detects compressions, the display activates targets for compression release and depth, and a compression rate indicator (Figure 6). For a list of all feedback displays, see Table 2 in this application note.

Figure 6: Beginning compressions on the CPR Meter.

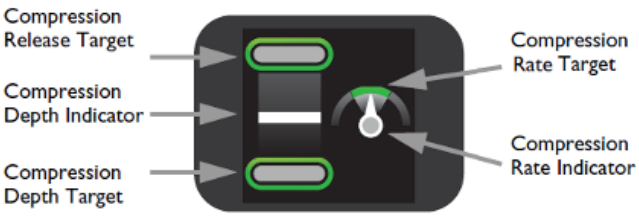


Figure 7: CPR Meter indicators.

Compression depth

When CPR is administered, the Q-CPR Meter 2 display indicates the compression depth, and whether pressure is not completely released after a compression. Use the Compression depth Indicator as an indication of proper compression depth (Figure 7).

Compression depth indicators	
Each compression performed is represented on the Q-CPR Meter 2 display by a moving white compression depth indicator bar. When the correct compression depth is achieved, the bottom target lights up. When the pressure is completely released, the top target lights up.	
If compression fails to meet the target depth (50-60 mm for a patient on a hard surface), the compression depth target zone does not light up. If four consecutive compressions fail to meet the depth target, a yellow arrow appears on the display, pointing to the depth target zone. If the compression depth is not corrected the HeartStart Intrepid provides corrective voice prompts (if configured).	
If the Q-CPR Meter 2 detects a compression that reaches 70 mm, the area below the compression depth target area lights up.	
If pressure is not fully released between four consecutive compressions, the Q-CPR Meter 2 display shows a yellow arrow pointing up to the compression release target zone. Allow the chest to completely recoil between compressions.	

Figure 8.

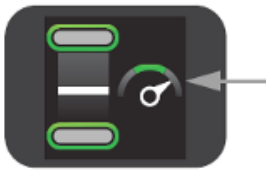
Compression rate

The Q-CPR Meter 2 also provides feedback on the rate of compressions and uses a speedometer to indicate whether to speed up or slow down the compression rate.

Compression depth indicators

If the Q-CPR Meter 2 detects the compression rate is within the target area, the speedometer needle on the compression rate indicator points to the green target zone, which lights up.

If the Q-CPR Meter 2 detects the compression rate is faster than the target rate (120 compressions per minute), the needle on the compression rate indicator points to the right of the green target zone. If the compression rate is not corrected the HeartStart Intrepid provides corrective voice prompts (if configured).



If the Q-CPR Meter 2 detects the compression rate is slower than the target rate (100 cpm), the needle on the compression rate indicator points to the left of the green target zone. If the compression rate is not corrected the HeartStart Intrepid provides corrective voice prompts (if configured).

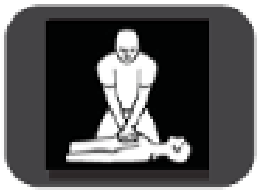
Figure 9.

Other Q-CPR Meter 2 display icons

The Q-CPR Meter 2 displays the Do Not Touch The Patient icon when the HeartStart Intrepid provides prompts to stop CPR to analyze the patient's heart rhythm, the device is charging or advises a shock is required. Stay clear of the patient when the icon is displayed.

NOTE: Do not remove the Q-CPR Meter 2 during rhythm analysis or shock delivery. Leave the Q-CPR Meter 2 on the patient's chest.

If compressions are stopped for 10 seconds, the Q-CPR Meter 2 display changes to a flashing white image to indicate that CPR should be resumed. If compressions are not resumed, the HeartStart Intrepid provides voice prompts (if configured) that no compressions are detected.



The Customer Service indicator appears only at shutdown when the number of compressions performed on the Q-CPR Meter 2 reaches the device's service limit (500,000 compression cycles). Take the Q-CPR Meter 2 out of service and contact a local response center for more information.

NOTE: Shut down the HeartStart Intrepid before disconnecting the Q-CPR Meter 2. Failure to do so may delay the appearance of the meter's Customer Service Indicator.

Figure 10.

Using Q-CPR on the HeartStart Intrepid

Q-CPR feedback is displayed on the Q-CPR Meter 2 and on the HeartStart Intrepid device screen. The HeartStart Intrepid can display the following parameters, depending upon configuration (Figure 4).

- Compression rate
- Compression wave showing compression depth
- No flow time (shown as No CPR sec on the display)
- Ventilation rate
- CPR Timer
- Compression counter

If the HeartStart Intrepid is equipped with the $EtCO_2$ option, the display also provides. (Figure 4).

- $EtCO_2$ numeric (if available)
- CO_2 wave (if available)

Using Q-CPR in AED Mode

In AED Mode, CPR feedback is provided automatically during the CPR Pause period of the AED protocol or manually when the CPR Pause soft key is pressed. If the No Shock Advised (NSA) Action configuration item is set to provide a CPR Pause interval, Q-CPR can be activated by delivering a compression with the Q-CPR Meter 2. Voice prompts are issued as guidance. (Figure 11).

AED Soft Keys

AED Mode has two soft keys available:

- **CPR** - Pressing the CPR soft key initiates the configured pause period to perform CPR.
- **Resume Analyzing** - Pressing the Resume Analyzing soft key initiates the AED analysis algorithm to resume or restart analysis.

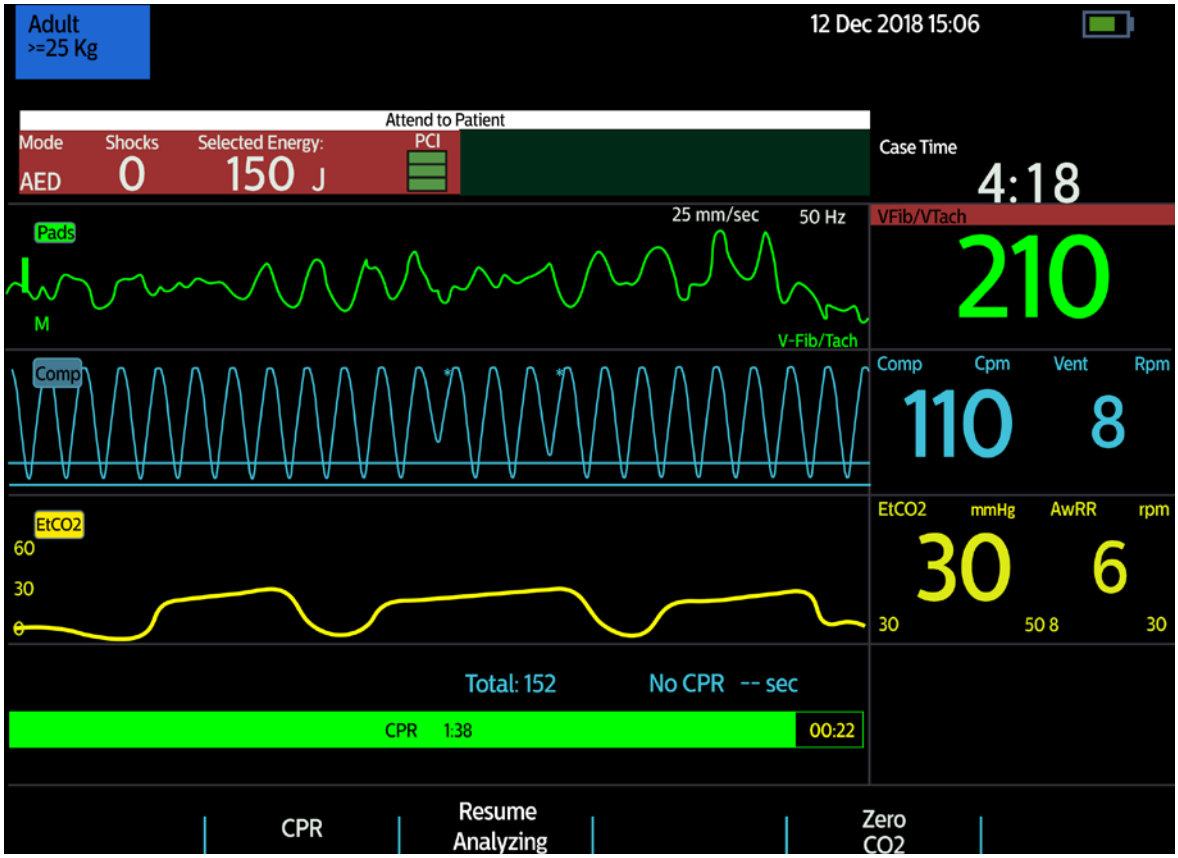


Figure 11.

Using Q-CPR in Manual Defibrillation Mode

In Manual Defibrillation Mode, the CPR view is automatically displayed only if the patient category is Adult and compressions are detected. If CPR voice prompts are not enabled, CPR Voice Muted displays beneath the progress bar. (Figure 12).

Soft Keys

- To stop CPR, press the [**Stop CPR**] soft key.
- To start CPR, press the [**CPR Timer**] soft key.

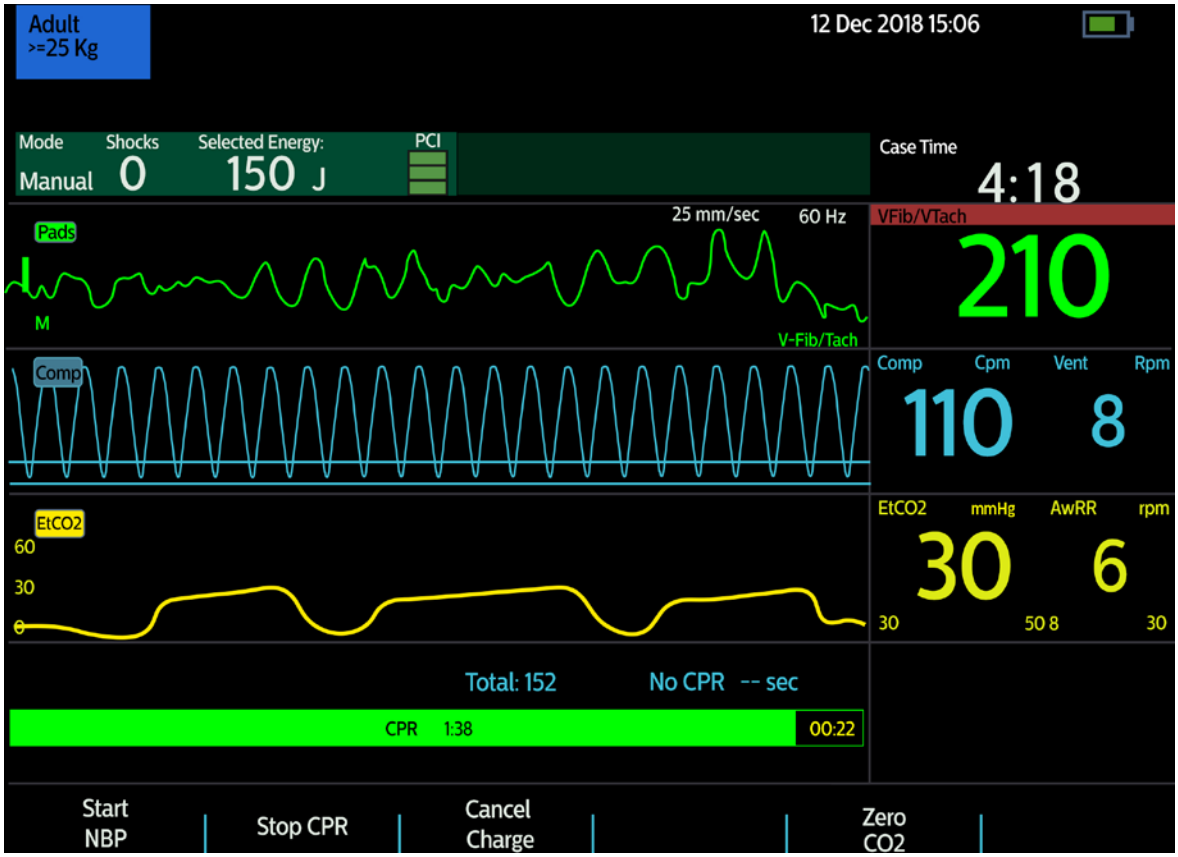


Figure 12.

User messages

Condition	Target	HeartStart Intrepid
Poor pads contact	Press pads firmly	“Press pads firmly to patient’s bare skin.”
Q-CPR meter not connected properly or pads not applied	Insert Connector, Apply Pads	“Insert connector firmly Apply Pads.”

Table 1: CPR user messages.

CPR Component	Problem	HeartStart Intrepid Voice Prompt
Compression Depth	Compression depth too shallow	“Compress Deeper”
Compression Rate	Compression rate too slow	“Compress faster””
	Compression rate too fast	“Slow down compressions”
Residual Pressure on the Patient’s Chest	Incomplete release of compression	“Release fully between compressions”
No Compression Activity	Compression inactivity or not detected	“No compressions detected”
Ventilation Rate	Too many ventilations	“Ventilate less often”

Table 2: CPR feedback prompts.

Conclusion

There is no question that performing quality CPR is challenging in the real world. The environment, patient type, fatigue, and training all affect performance. Philips HeartStart Intrepid monitor/defibrillator Q-CPR function and Q-CPR Meter 2, provide immediate, objective measurement and corrective feedback on compression and ventilation to encourage CPR performance in accordance with established guidelines.

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