



## The Polar® Heart Rate Exercise Sensor

(Product No. 3148)

Range: 0 - 220 beats per minute (bpm)



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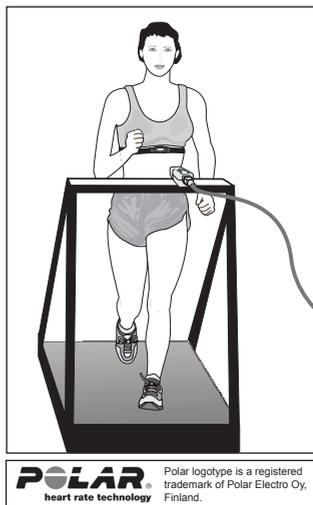
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## Introduction

The *Smart Q* Polar® Heart Rate Exercise Sensor monitors the electrical signal of a person's heartbeat. Each time the heart beats an electrical signal is generated. This signal is measured at the surface of the skin by two electrodes that are embedded in the Polar® transmitter belt. The belt is worn across the lower part of the chest, around the ribcage against the skin (under clothing). The heart rate information is transmitted wirelessly to the *Smart Q* Heart Rate receiver through a low frequency electromagnetic field. This will allow heart rate to be measured even during exercise.

The *Smart Q* Polar Heart Sensor consists of:

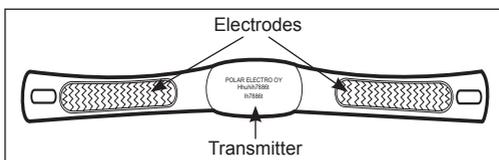
1. The *Smart Q* Heart Rate receiver.
2. The Polar transmitter belt. The belt has two parts - the Polar transmitter (T31) and an elastic belt to hold it in place. Two different sized elastic belts are supplied, small (58 to 120 cm or 23" to 47") and large (69 to 160 cm or 27" to 63").



The **EASYSense** unit can detect when the *Smart Q* Polar Heart Rate Exercise Sensor is connected.

## Fitting the Polar transmitter belt

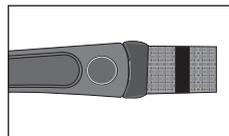
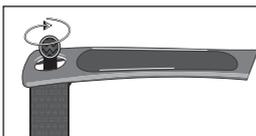
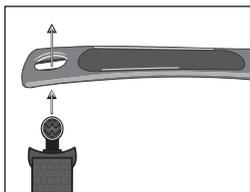
The Polar transmitter belt contains two electrodes to detect the electrical signal on your skin. The electrode areas show as two rounded rectangular shapes marked with zigzag groves.



The Polar transmitter detects the voltage differential on the skin during every heart beat and sends the signal continuously and wirelessly using an electromagnetic field to the *Smart Q* Heart Rate receiver.

**Note:** *The Polar transmitter belt has no on/off switch. The transmitter will activate as soon as skin contact is made between the two electrodes.*

- Depending on the chest size of the test subject select either a small or large elastic strap. Attach the adjustable elastic belt to one end of the transmitter belt by feeding the clip on the elastic belt into the slot from the front, turn and then flatten into place to lock.



**Note:** *The elastic strap needs to be stretched in order for the electrodes to make good contact with the skin. We found the small belt (marked S on the Polar label) fitted a 63 to 115 cm (25 to 45 inch) chest and the large (marked L) fitted a 74 to 155 cm (29 to 61 inch) chest.*

- Position the Polar transmitter belt on your chest with the centre of the belt at the centre of your chest, just below your pectoral muscle, (at heart level). If positioned correctly the Polar logo will be in a central upright position. Adjust the elastic strap so it fits snugly (but not too tight). Make sure the belt is resting directly against the skin.

**Note:** *If the electrode area does not make full contact with the skin (e.g. if the test subject has a very small chest) try moving the transmitter belt higher or lower or move it round to the test subjects back and position at heart level.*

If your skin is dry there may not be sufficient body sweat to allow good conduction between the skin and the two transmitter electrodes. If so, moisten

the electrode area on the underside of the belt (the side that goes against your skin) with a few drops of water or a saline solution e.g. a 5% saline solution (5 g of NaCl per 100 ml of water).

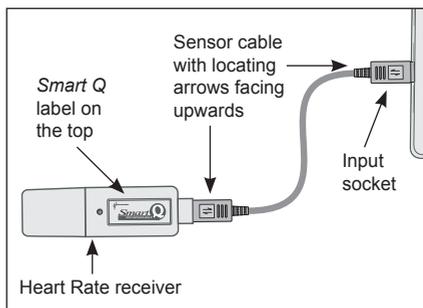
**Notes:** An alternative would be to use a suitable conductive skin gel e.g. electrode gel or K-Y gel. Restrict the application of conductive gel to the electrode areas only.

The electrodes may need to be rewet each time the belt is repositioned.

- Secure the strap and lock the buckle.

## Connecting the Smart Q Heart Rate receiver

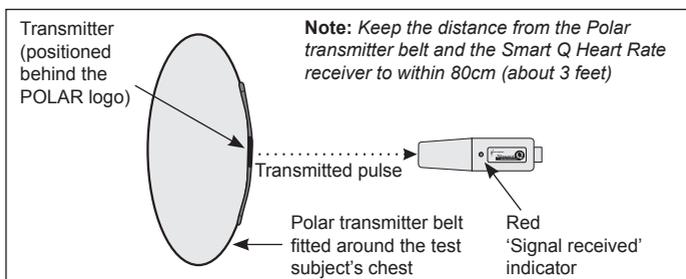
- Hold the Heart Rate receiver housing with the *Smart Q* label showing on the top.
- Push one end of the sensor cable (supplied with the **EASYSense** unit) into the shaped socket on the Heart Rate receiver with the locating arrow on the cable facing upwards.
- Connect the other end of the sensor cable to the input socket on the **EASYSense** unit (with the locating arrow facing upwards).
- The **EASYSense** unit will detect that the *Smart Q* Polar Heart Sensor is connected and display calibrated readings in beats per minute (bpm).



**Note:** The red LED on the *Smart Q* Heart Rate receiver is **not** a power on indicator; it is used to indicate that a signal has been received from the Polar transmitter belt.

## Measurement procedure

An important part of setting up the *Smart Q* Polar Heart Sensor is good positioning between the Polar transmitter belt and the *Smart Q* Heart Rate receiver.



Position the *Smart Q* Heart Rate receiver so it points towards the centre of your chest i.e. pointing at the transmitter at the centre of the Polar transmitter belt.

**Note:** Place the Smart Q Heart Rate receiver so it won't get knocked during exercise.

The transmitter will send a pulse corresponding to each heartbeat. The red 'signal received' LED on the *Smart Q* Heart Rate receiver will light each time it receives a signal (in time with the heart beat). Wait for about 20 seconds for the signal to stabilise before starting to collect data. Once a steady heartbeat is detected begin recording data.

Clean and dry the Polar transmitter belt after use.

## Care and maintenance of the Polar transmitter belt

The transmitter is sealed, 100% waterproof and ECG accurate.

The transmitter will switch off automatically as soon as there is no skin contact between the electrodes.



Clean the transmitter after use with a mild soap (dish washing detergent or hand soap) and water solution. Dry carefully with a soft towel after washing. Never use alcohol, abrasives or a solvent-based detergent, as they will cause permanent damage to the electrodes.

Store the transmitter dry. Sweat and moisture on the electrodes can keep the transmitter activated, which will shorten battery life. Store the belt in a 'breathable material' (e.g. cotton fabric) in a cool, dry place.

Try not to over bend or stretch the transmitter belt during use or storage as this may damage the electrodes.

The Polar transmitter belt is powered by a 3 V Lithium battery, providing an average of 2,500 hours of use. When the battery becomes weak or empty the Polar T31 transmitter part of the belt will need to be replaced. A replacement is available from Data Harvest - use *Product No. 3272*.



An indication that you may need to replace the transmitter belt would be if:

- The range between the transmitter and receiver needs to be less than expected to work.

- The heart rate reading stays at the same value for a long time.
- The receiver does not blink.

Small and large size replacement elastic belts for the Polar T31 Transmitter can be purchased from Data Harvest.

Size	Length of transmitter and elastic belt	To fit chest size (approximately)	Product No.
Small	58 to 120 cm (23 to 47 inches)	63 to 115 cm (25 to 45 inches)	3273
Large	68 to 160 cm (27 to 63 inches)	74 to 155 cm (29 to 61 inches)	3274



## Technical data

The Polar transmitter belt is a non-coded type T31 and can be used independently of the *Smart Q* Polar Heart Rate Exercise Sensor. It is compatible with many types of Polar heart rate monitors. A full compatibility chart is available on the Polar website.

Receiver range: 80 - 100 cm.

Transmitter transmission frequency: 4.8 kHz - 5.6 kHz (typical 5.2 kHz).

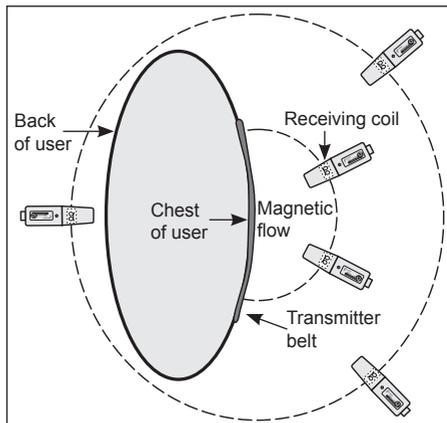
Transmitter operating temperature: 0 - 60°C.

Lifespan: about 2,500 transmit hours if stored correctly (dry).

## Practical information

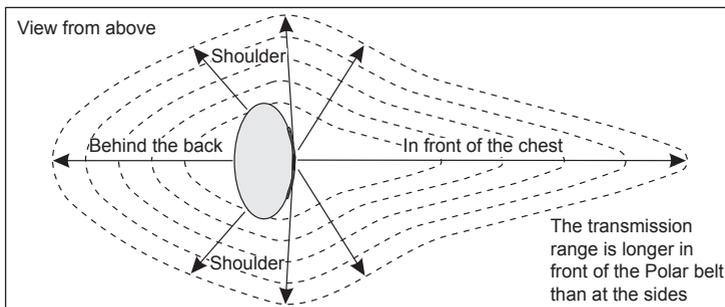
### Signal information

- The Polar transmitter sends a signal to the *Smart Q* Heart Rate receiver for each heartbeat. The microprocessor in the *Smart Q* Polar Heart Rate receiver uses the time interval between these signals to calculate the current averaging to ensure a reliable stable heart rate reading so may take a few seconds to stabilise.
- If the *Smart Q* Heart Rate receiver should lose contact with the Polar transmitter it can take a few seconds to go to zero (during which time it will display the last recorded reading).
- The orientation of the *Smart Q* Heart Rate receiver can be important in receiving a stable signal (red LED flashing regularly).

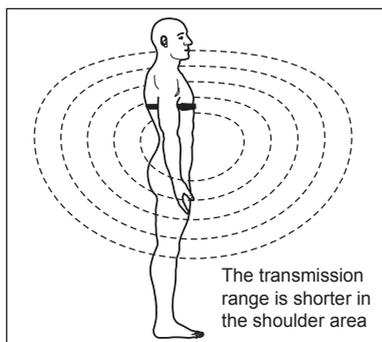


The coil axis of the receiving coil (fitted inside the *Smart Q* housing) needs to be parallel with the magnetic flow created by the transmitter in the Polar belt in order to get the best results. Altering the angle at which the *Smart Q* Heart Rate receiver points at the transmitter can improve the signal.

- The distance from the Polar transmitter belt and the *Smart Q* Heart Rate receiver should not exceed 80 cm. If the red signal received LED flashes erratically, move the receiver outside of the reception range and then move it closer until the flashes are regular. This will be the maximum reception range at this point. If you are exercising make sure that any movement is well within the maximum reception range.
- There maybe 'zones' where the distance between the *Smart Q* Heart Rate receiver and the Polar transmitter belt need to be reduced to less than the quoted maximum transmission range.



Example: With this test subject the receiver needed to be positioned closer than 80 cm to the transmitter to get a stable signal when positioned in front of the user's shoulders.



- The *Smart Q* Heart Rate receiver will receive signals from the closest Polar® transmitter source, and that will include another transmitter belt if it's within range. Keep a distance of at least **2 metres** between different users of the Polar Heart Sensor.

- Some users may find it possible to get a heart rate reading just by touching the electrode areas with their fingers - touch the left electrode with a finger from one hand and the right electrode with a finger from the other hand.
- Strong electrical and electromagnetic fields may cause difficulties by interfering with the low frequency electromagnetic field that is used to transmit information between the transmitter belt and the receiver. These disturbances can cause erratic and faulty heart rate readings. The equipment that can produce such interference includes computer monitors, televisions, mobile phones, switching power supplies, electric motors, electronic exercise equipment and high voltage power lines. Most disturbances are both directional and distance related. Keep the *Smart Q* Heart Rate receiver of the Sensor as far away as possible from the source of interference (1.5 metres plus) and at the same time try to reduce the distance between the receiver and the Polar transmitter belt.
- Static electricity in clothing can cause electrical interference. Some items of clothing (i.e. man-made fibres) can also cause unusual readings.
- Dirty electrodes can cause poor readings, see care and maintenance on page 4.

### Time span

The signal from the Polar transmitter is sent each time the heart beats (e.g. this would be once a second at 60 beats per minute). Data is best collected with a minimum interval between readings of 1 second.

The fastest speed that data can be captured is 50 Hz (20 ms). If an intersample time of less than 20 milliseconds is selected, then the values obtained will either default to the lowest reading or the set up will be rejected by the logger/software.

### Power requirements

The *Smart Q* Heart Rate receiver takes its power direct from the **EASYSense** unit. Once connected the receiver will remain active (permanently powered) ready to receive a signal from the transmitter belt.

#### **Notes for EASYSense Q Advanced, Advanced, Q3, Q5 and Logger users:**

- *The Smart Q Heart Rate receiver will use power even if the EASYSense unit is off (LCD screen blank). If the receiver is to be connected for long periods of time, charge up the EASYSense unit's batteries or use connected to an external power supply.*

#### **Notes for EASYSense Flash Logger users:**

- *When the Smart Q Heart Rate receiver is connected via the Flash Logger to a PDA it will use power even when it's not taking any samples. Disconnect the Smart Q Heart Rate receiver when not in use.*
- *If the receiver is to be connected for long periods of time, charge up the PDA's batteries or use connected to an external power supply.*

## Trouble shooting

*The red LED on the Smart Q Heart Rate receiver isn't flashing.*

The red LED only lights when it receives a signal from the Polar transmitter. Try moving the receiver closer to the transmitter.

*The red LED is flashing but values are shown as a constant flat line of zero.*

Check the intersample time selected is not less than 25 milliseconds.

*The red LED on the receiver flashes but the LCD screen on the **EASYSENSE** unit is blank.*

The LED will flash when the receiver detects a signal from the transmitter - it does not activate the **EASYSENSE** unit. If the **EASYSENSE** unit is off or asleep between readings, press any of the buttons on the top panel of the **EASYSENSE** unit to view the current measurement.

*The reading didn't alter and then dropped down to zero*

The receiver has lost contact with the transmitter, which will result in the reading momentarily dropping to zero while it attempts to re-establish communication.

Try:

1. Tightening the transmitter belt and/or place 2 drops of saline solution on each of the electrodes on the belt.
2. Moving the receiver closer to the transmitter.
3. Altering the angle at which the receiver points towards the transmitter.

The *Smart Q* receiver has to estimate beats-per-minute every second so a lost reading will affect the calculated pulse rate for a few seconds.

## *Sudden spikes of data*

The receiver may be picking up interference from nearby equipment. Adjust the position of the receiver.

## Heart Rate

Heart rate can vary with age as shown below:

Age	Average Heart Rate (beats per minute)
Newborn	140
7 years	85 - 90
14 years	80 - 85
Adult	70 - 80

In normal healthy individuals the heart rate varies with the phases of respiration. Irregular changes in heart rate occur in all people. Heart rate may be increased by

exercise, nervous excitement, stress due to mental effort, by adrenaline entering the bloodstream or with increase in temperature caused by fever. The heart rate decreases when asleep and with some medical conditions.

## Effect of Exercise

Physical training can increase the efficiency of the heart and thus the resting heart rate is decreased. The athlete's heart is usually larger than that of an untrained individual. Constant training, with its increased workload against which the heart must contract, results in enlargement of the myocardial fibres with associated biochemical changes. This modifies the performance of the heart, increasing stroke volume (the volume of blood pumped by the heart at each beat), and permitting the athlete to achieve the same cardiac output with a slower heart rate. The resting heart rate in an athlete may be as low as 40 - 50 beats per minute, but with an increased stroke volume of 100 - 110 cm<sup>3</sup> (compared with 70 - 80 cm<sup>3</sup> in an untrained individual).

With increased heart rate it would be expected that stroke volume would decrease because less filling time is available. In fact, during exercise the sympathetic nervous system acts to increase it, by increasing the vigour of myocardial contraction. As a result, the output of the heart per minute tends to increase proportionately with increase in heart rate.

## Recovery Time

Following exercise it takes a while for the heart rate to return to resting level. This is the recovery time and gives an indication of the fitness of the individual. Recovery time may vary from less than five minutes in very fit individuals to around 15 minutes.

## Safe Pulse Rates

During experiments the safe heart rate should not be exceeded. The safe level is given as the maximum heart rate for age, minus 20 beats per minute.

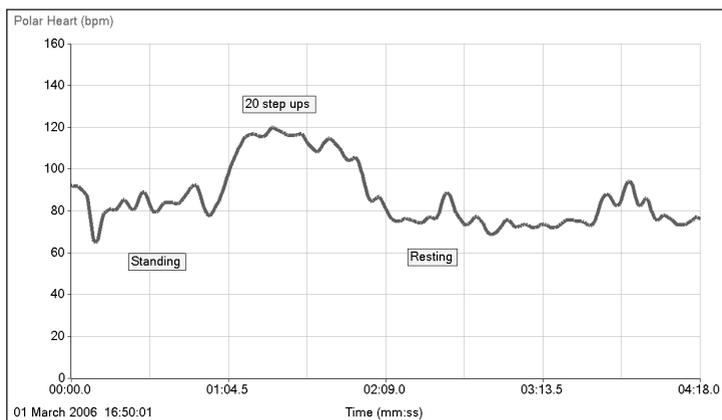
Maximum heart rate = 210 - (0.65 x age)

Age	Maximum Heart Rate	Safe Heart Rate
12	202	182
13	202	182
14	201	181
15	200	180
16	199	179
17	199	179
18	198	178

It is important that investigations do not become a competition. Consider any possible health problems before selecting the test subject.

## Investigations

- Compare the heartbeat of different individuals; try to include both athletic and inactive people.
- Monitor the heart rate before and during brief vigorous activity.



- Monitor the speed at which the heart rate returns to normal following exercise (recovery rate).
- Monitor changes to the recovery rate of a subject who is undergoing a fitness regime.
- Compare heart rate when breathing normally and when holding your breath.
- Change in heart rate due to everyday activity e.g. talking, breathing, etc.
- Check for baroreceptor reflex: that is changes in heart rate for a person when reclined, sitting, standing or moving, caused by the heart pumping blood to different levels.
- The effects of a mild stimulant such as caffeine in cola or coffee.

## Warranty

All Data Harvest Sensors are warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided they have been used in accordance with any instructions, under normal laboratory conditions. This warranty does not apply if the Sensor has been damaged by accident or misuse.

The Polar transmitter belt is backed by a two year maintenance free warranty (including the battery) from Polar USA.

In the event of a fault developing within the 12-month period, the Sensor must be returned to Data Harvest for repair or replacement at no expense to the user other than postal charges.



WEEE (Waste Electrical and Electronic Equipment) Legislation

Data Harvest Group Ltd are fully compliant with WEEE legislation and are pleased to provide a disposal service for any of our products when their life expires. Simply return them to us clearly identified as 'life expired' and we will dispose of them for you.

**Note:** Data Harvest products are designed for **educational** use and are not intended for use in industrial, medical or commercial applications.