



Power Play

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Power meters – we’ve all heard about them but what are they? What do they actually do? Most importantly, what can they do for me?

Power meters have been used by the peloton since the 1980s. They can be bottom bracket based, pedal mounted, chainstay, rear hub or crank fitted. Greg Lemond was one of the first professionals to start using a power meter and back in the day they cost around \$10,000 – little wonder there weren’t that many out there. In about 1989 they started becoming commercially available and it didn’t take long for word to spread that the benefits of training and racing with power can help you more than just training in heart rate zones. Nowadays you’ll find the majority of the peloton are riding around with an SRM or a Quarq on their cranks.

So what is power? Most power meters use strain gauges to measure torque applied either to the bottom bracket,

pedal, rear hub or cranks. Strain gauges measure pressure applied by the force of the body, which is measured in Watts. So what is a Watt? Firstly let’s touch on the joule. A joule is a metric standard unit of energy, so 1,000 joules is a kilojoule. And a joule is what you actually see on a power meter display; one watt equals one joule. So when you’re riding at 250 watts you’re actually generating 250 joules of mechanical energy each second. Another way to understand power is this: the units measure torque applied, combined with angular velocity, to calculate power. Now you need to consider what it takes to create a watt of power. Power equals velocity* (drag + inertia + rolling) force + (gravity) + (work) time. When you are riding your bike, it’s not only your legs you need to think about to enable to you to sit on 260 watts for an hour, it’s also rolling resistance, drag, airflow and whether you are climbing or descending.

A Power Meter on your Bike

Over the years some exciting technology has been released. Now power meters can be found on the crank spider, the rear hub, the chainstay, the pedals, the bottom bracket, the handlebars and one of the latest ones to be released is on the left crank arm. ANT+ connectivity is the current standard, which means compatibility with most current GPS units without messy wires. So what are the pros and cons?

The first company to make power meters available commercially was SRM, and to this day they are the market leaders. SRM is a spider-mounted meter which uses strain gauges to measure power applied through the cranks. Quarq have followed suit with this technology and both products are fantastic, but the limitation for the average rider is that you can’t easily move these from one bike to another. Overall these are some of the lightest power meters available.

The next two systems are both by the same manufacturer so I’ll describe them together. Polar brought out a power meter which mounted to the chainstay and used technology that measured the vibration frequency omitted from the chain. It’s very much like a guitar translating the vibrations of your finger on the string and then emitting a sound. This technology has been found to have a few holes compared to other devices and as such hasn’t really been popular. Polar also developed a pedal-based power meter, but again there has been some inaccuracy with its readings. Garmin also followed suit developing a pedal-based power meter called the Vector, but they also hit some issues. Their product was due to be released in 2011 but we’re still waiting to see it. This technology is a simple lightweight attachment for the pedal. The idea of this type of power meter is fantastic because it would be very easy to transfer from one bike to another.

PowerTap, iBike and Ergomo

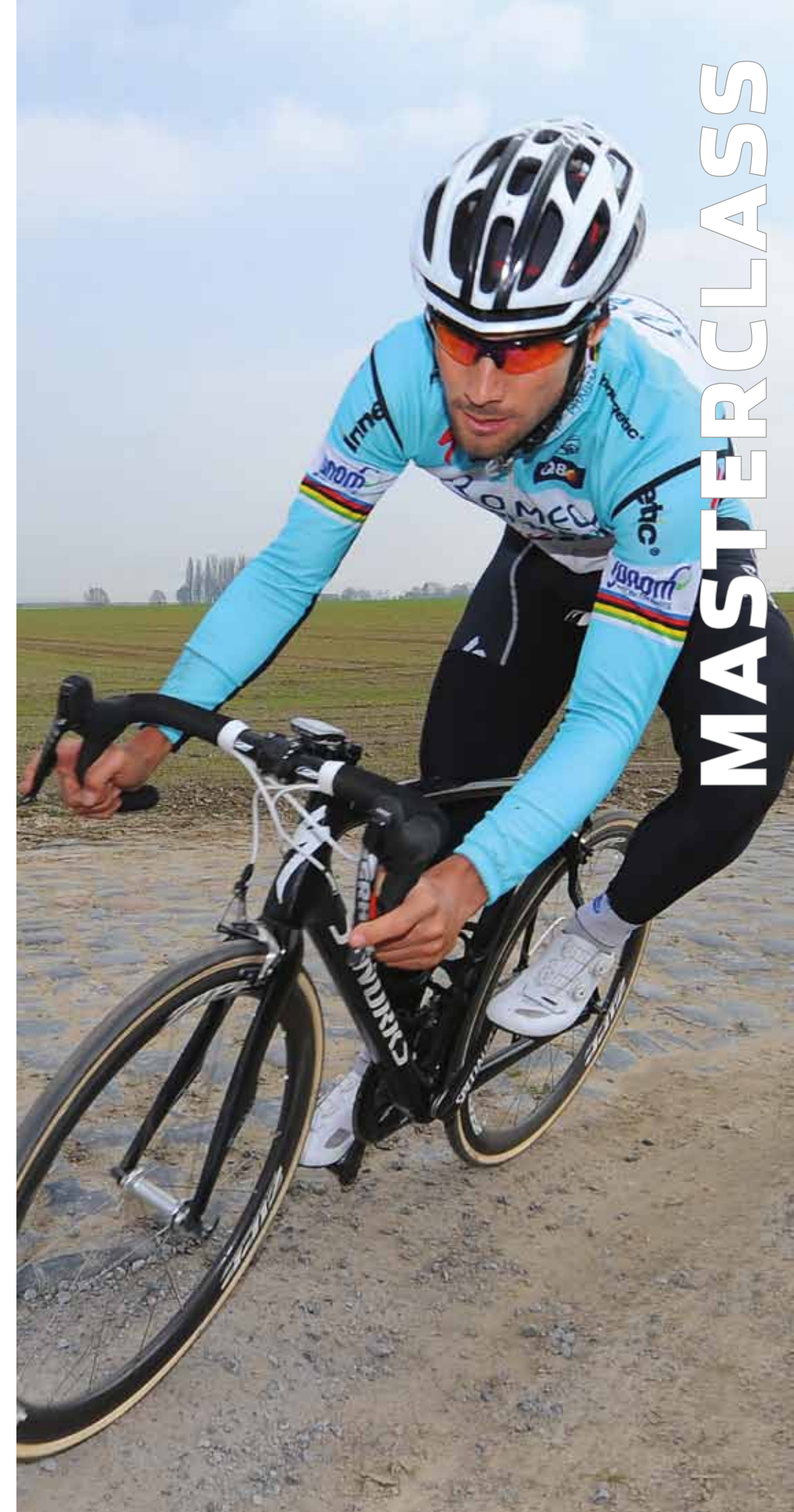
PowerTap hit the market with a great product. Being located in the rear hub made it easy to transfer from one bike to another, but the downside is that they are heavy and you wouldn’t want to race on such a heavy wheel. They are overcoming this by developing lighter rear hubs. Another downside with the system is that it measures power that is actually going to the road, whereas a crank-based system measures what you are actually putting into the first point of contact. With a rear hub system you lose about 5-10 watts compared with a SRM or Quarq but there is also the argument that the PowerTap design is more ‘real world’ measurement.

The bottom bracket system by Ergomo is comparatively rare and it hasn’t really taken off due to bottom bracket choice restrictions and a lack of transferability to different bikes. With the Ergomo being a totally sealed unit, one of the biggest concerns is not knowing how long its bearings will last. If they were to join forces with a larger component player we may see more of them.

Power meters will not only give you numbers to play with and learn from, they will also increase your motivation by helping you understand what you are capable of

I mentioned a handlebar-mounted system, though to date I have never actually seen one. But the concept is very interesting. It was developed by iBike/iAero and it measures the force needed to create movement against air resistance. What it needs to give accurate power measurements is your weight, an aerodynamic coefficient and a rolling resistance number to determine the actual power. The benefit of this system is that it can also help your riding technique. With the aerodynamic factor taken into account, the iAero will let you know at the end of a ride if you actually saved time by being in a tucked (aerodynamic) position and if so, how much. For a time trial specialist this is priceless and for any rider it could make a considerable difference.

Last but not least is the latest to come to market, released at Bike Expo in the United States. It’s been developed by StageOne and shows lots of promise. It will be the lightest power meter on the market, weighing in at only 20 grams





and can be fitted to certain left hand side crank arms (for now). Information is still very limited – at the time of writing, their website was not operational. The product is due to be released in early 2013 and could certainly be one to watch.

Here is a brief summary on the power metres mentioned. You will find they all have pros and cons and it will always come down to what you want and what you're going to be happy with. They range in price from AUD\$800-\$4,000 and have margins of accuracy from +/- 1.5 to +/- 5.0. Then you need to consider weight, with units ranging from 20 grams to 950 grams. All of these utilise ANT+ so take into account what head unit you may like to use for display purposes.

Power Over Heart Rate

You now have an idea of what power is and what devices we can use, so what should you be training with, power and/or a heart rate monitor? Why use power instead of heart rate? Simple. Power gives you immediate feedback from the force used. Heart rate is measured by the physiological effect, or effort needed, and will have a delayed increase. Additionally, your heart rate is affected by several different factors. Temperature, hydration, sleep, mood, stress and illness all play a part in what your heart rate will do. Before heart rate monitors, an athlete gave a perceived effort on a scale of 1-10. This is called the Gunnar Borg's Ten Point category. Then along came heart rate monitors and now of course power meters. The notable difference is that your heart rate could stay the same over a period of time but your actual power output could be declining, and a heart rate monitor won't tell you that. For example, you're doing a 30km time trial and at the 5km mark, your heart rate is sitting at 90 per cent and you're pushing out 260 watts. Then at the 10km mark, your heart rate has only gone up to 91 per cent but your power has dropped to 250 watts. With a heart rate monitor you wouldn't be aware of this, which leaves you blind to what you should be doing for the rest of the time trial.

Do you remember the last time you



SRM units are the original power measuring device and still the industry benchmark. But the competition isn't far behind.

sat for an exam and you could feel the nerves building up and your heart starting to thud? That was your heart reacting to stimulus; this can be brought on while just sitting there. So your heart rate is just a little part of the big picture. If you had a heart rate monitor on at that time, you would see your heart rate rise. But if you had a power meter, it wouldn't register a thing because you're stationary. A power meter can't lie; it tells you exactly what power your body is producing to gain forward momentum.

You can greatly benefit from training and racing with a power meter. It allows you to track your fitness changes by enabling you to see your strength and weaknesses. Then you can re-focus your training on your weaknesses and maintain your strengths. Doing all this allows you to maximise your training time, leaving the numbers up to your coach to sort out.

The information you can gain from a power meter could be from your weekend ride with mates, or a race.

One thing you will notice when you start with a power meter is that you look down at the numbers and think that the power meter is broken because the numbers are jumping around so much. One second you see 350 watts, the next it's down to 200 watts. Don't worry. This is perfectly normal, it occurs due to the conditions and the settings you have for the power to display. Setting the power meter to display every 30 seconds average is the best way to display a stable number to work with. The only true way to get a consistent number is by using a trainer. There's no influence of the road surface or wind; you can have that fan on its highest setting, but it won't change anything.

Having a power meter will allow you to compare who had the highest watts for a particular climb or who was the strongest in the sprint to the coffee shop. All that information can and will tell you a lot about yourself. Just from those two points, you could learn that you're a stronger climber than Johnny because you pushed out an average 310 watts and Johnny was dropping off and could only get 285 watts on the climb. But Johnny smashed you to the coffee shop because he was able to push out 1150 watts and you only managed 900 watts. Just from that you know you should be working more on your anaerobic system by doing short interval sessions and hill sprints.

Working on the Numbers

So what other information is in it for you? Well, linked with a number of software packages, the information is endless and can be very confusing.



Pedal based measuring systems are handy as they're easy to swap from bike to bike.



Power meters will give you information like your TSS (Training Stress Score), IF (Intensity Factor), CTL (Critical Training Load), ATL (Accumulated Training Load), TSB (Training Stress Balance), NP (Normalised Power). The first port of call to make all that data accurate is to find out what your FTP (Functional Threshold Power) is. It is important to learn as much as you can about all these things but it can be very daunting. Finding a coach who understands power, and coaches with the data, is the right way to go.

If you've read this far, it's likely that you want results and you want to improve your riding. However, don't think that getting a power meter will guarantee improvement. You need to translate the data into a training regime that will work for you. To do that you need to know when you're going to hit the right TSB; can you get that to coincide with the goal event you have for the year? There's no use training for countless hours and kilometres to find that you've peaked either too early or too late for that once-a-year goal.

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Power meters will not only give you numbers to play with and learn from, they will also increase your motivation by helping you realise what you are capable of. Can you remember the last time you did a monster climb and looked down at your heart rate monitor and saw it hitting 95 per cent, and you thought you were going to blow before you reached the top? Well you'll probably find that you really didn't need to worry about that too much at all because if you had a power meter you would've looked down and said, gee I've only dropped 10 per cent of power from the start, or I'm still within my functional threshold power (FTP).

This could also be the case in a breakaway in a road race, crit, time trial or a mountain bike race. If you know your FTP and your power ranges, you can gauge what your body is doing and ride accordingly. As previously mentioned with heart rate, in those situations there

are countless other factors that could send your heart rate to 95 per cent. Also, that 95 per cent could've occurred 30 seconds ago, or even a few minutes earlier, but it only translated to the data you're seeing now. This is all due to the body still adapting to previous stresses. So when your HR was showing 95 per cent, your power could have only been 80 per cent of your FTP. It is great to have your HRM to work with and in conjunction with power, they are both powerful tools that will tell you a lot. Always remember that HR is what has happened, power is what is happening now.

One notable thing you can do with both is work on your aerodynamics. Similar to the iAero mentioned before, you can see the benefits from changing your position on the bike with a HRM and power monitor. For example, imagine yourself riding along on the hoods, you look down and see your HR at 85 per cent and your power is 275 watts. You move down to the drops, lower your head and flatten your back over the bike. You look down a minute later and see that your HR has dropped down to 83 per cent and your power has risen to 290 watts. What you've done there is changed

your total wind resistance, and in doing so made riding easier and given your legs the chance to pedal with an extra 15 watts. If anyone ever offered me an extra 15 watts and a heart rate reduction for free, I'd jump at it. The funny thing is that everyone can have it. Why pay \$5,000 for a frame or \$4,000 for a set of wheels that offers you a five per cent reduction in drag, when all you need to do is adapt what you're currently doing by looking at your power meter and seeing what works for you? Power gives you the ability to train at your best, to achieve those goals we all work so hard for.

If you've been training with a heart rate monitor for years and feel like you've reached your peak, think again. Look at getting a power meter and really open your eyes to what you can achieve. There are endless possibilities to a power meter and the information they provide. They also give you the ability to train to your strengths and weaknesses. Understanding and using this data is what it's all about; it's not because Johnny's SRM unit looks awesome on his bike. It might look great, but Johnny hasn't improved at all over the last six months. Research and training are the keys. 



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