Introduction

The patented i-shifter™ integrated mountain bike shifter was designed to optimize derailleur based shifting performance. This single shifter employs an optimal shift pattern to operate both front and rear derailleurs simultaneously so that large changes in gear ratio and undesirable cross chain conditions are eliminated. Gear ratios increase progressively at an even rate while all redundant gear combinations are eliminated. The optimal shift pattern, which is built into the shifter, only requires the cyclist to twist a single handgrip in one direction to shift to a lower gear and in the opposite direction to shift to a higher gear. This simplicity of operation eliminates shifting errors and is apparent to the user immediately. From a rider's perspective, using a shifter that employs an optimal shift pattern represents a significant advance in shifting performance as it takes all of the guesswork and mistakes out of shifting gears.

Conventional shifters work well to shift their respective derailleurs independently. The only problem with this arrangement however, is that overall shifting performance does not depend solely on the performance of independent components but also on using the components in a coordinated manner. Because conventional shifters control the front and rear derailleurs independently, the cyclist is required to synchronize the function of both derailleurs in order to achieve the desired overall gear ratio. Unfortunately, we are not very good at doing this from a mechanical efficiency perspective. In fact, it is not uncommon for a considerable proportion of recreational riders to ignore the front derailleur and only shift with the rear derailleur. Not surprisingly, problems shifting gears is one of the most frequently mentioned complaints consumers identify when asked to evaluate the riding experience.

Shifting Guidelines

In theory, when shifting from the lowest gear ratio through to the highest, one should attempt to shift with as even an increment in gear ratio change as the derailleur gear system will allow. In addition, one should strive to shift in such a manner so as to avoid cross chain gearing in order to reduce drive train wear. Although we agree that shifting according to these two guidelines is the ideal way to use a derailleur based drive train, it is nearly impossible for any cyclist to accomplish when frequent shifting is required. This is especially true when riding in technically demanding terrain.

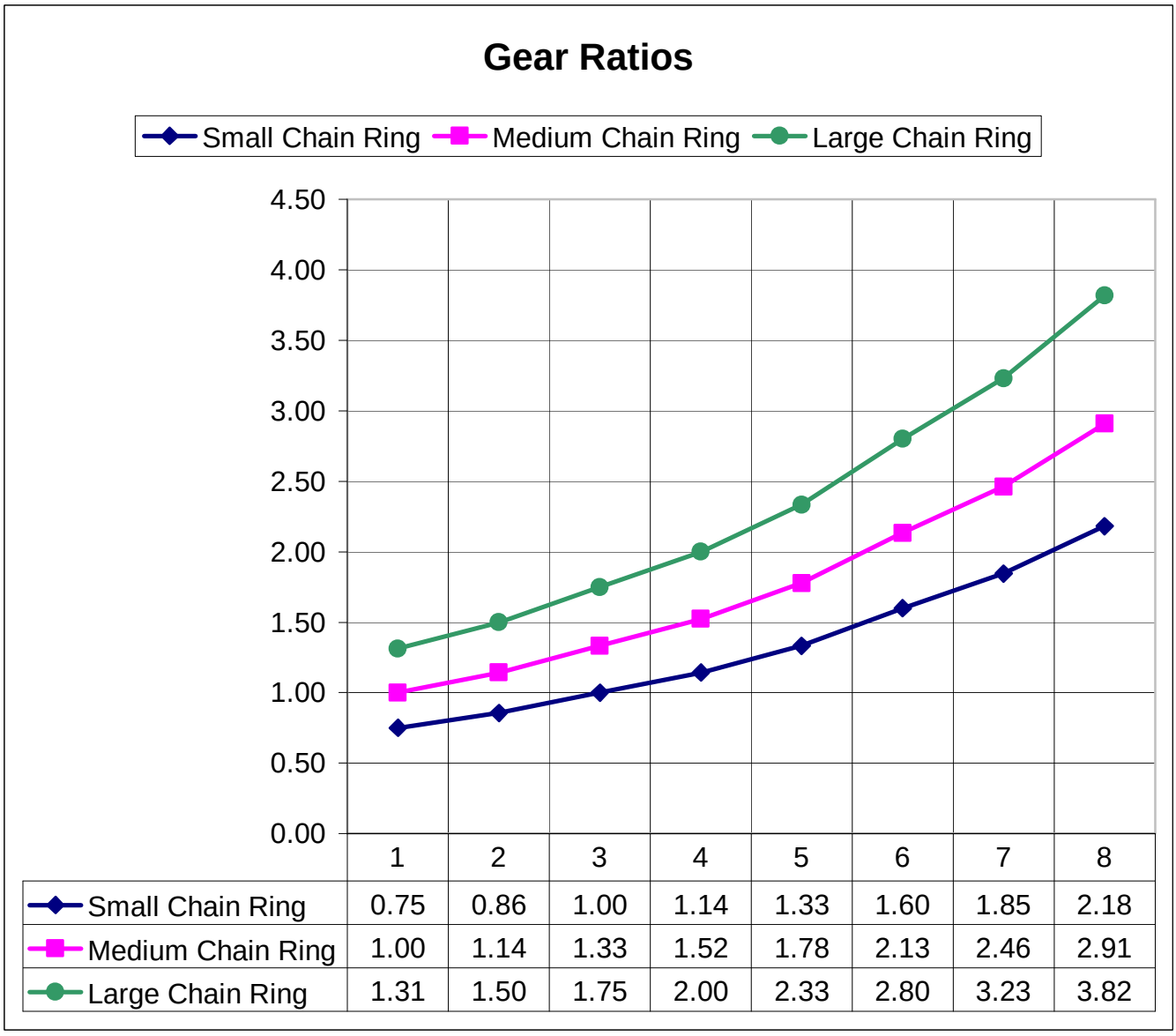
Actual Gear Ratios

Of all the gear ratios available to the cyclist, we find that roughly half are redundant. This redundancy limits the actual number of useful gears on a 24-speed transmission to 12. In the table below, redundant gears and cross chained gears combinations are grayed out.

		Chainrings			Ratio Change	
		24	32	42		
Rear Cogs	11	2.18	2.91	3.82	0.59	11 to 12
	13	1.85	2.46	3.23	0.43	10 to 11
	15	1.60	2.13	2.80	0.34	9 to 10
	18	1.33	1.78	2.33	0.33	8 to 9
	21	1.14	1.52	2.00	0.36	7 to 8
	24	1.00	1.33	1.75	0.25	6 to 7
	28	0.86	1.14	1.50	0.19	5 to 6
	32	0.75	1.00	1.31	0.19	4 to 5
					0.14	3 to 4
					0.14	2 to 3
					0.11	1 to 2

In the following charts, gear ratios are plotted to illustrate this redundancy. Chart 1 shows the gear ratios associated with each chain ring on a typical 24 speed transmission.

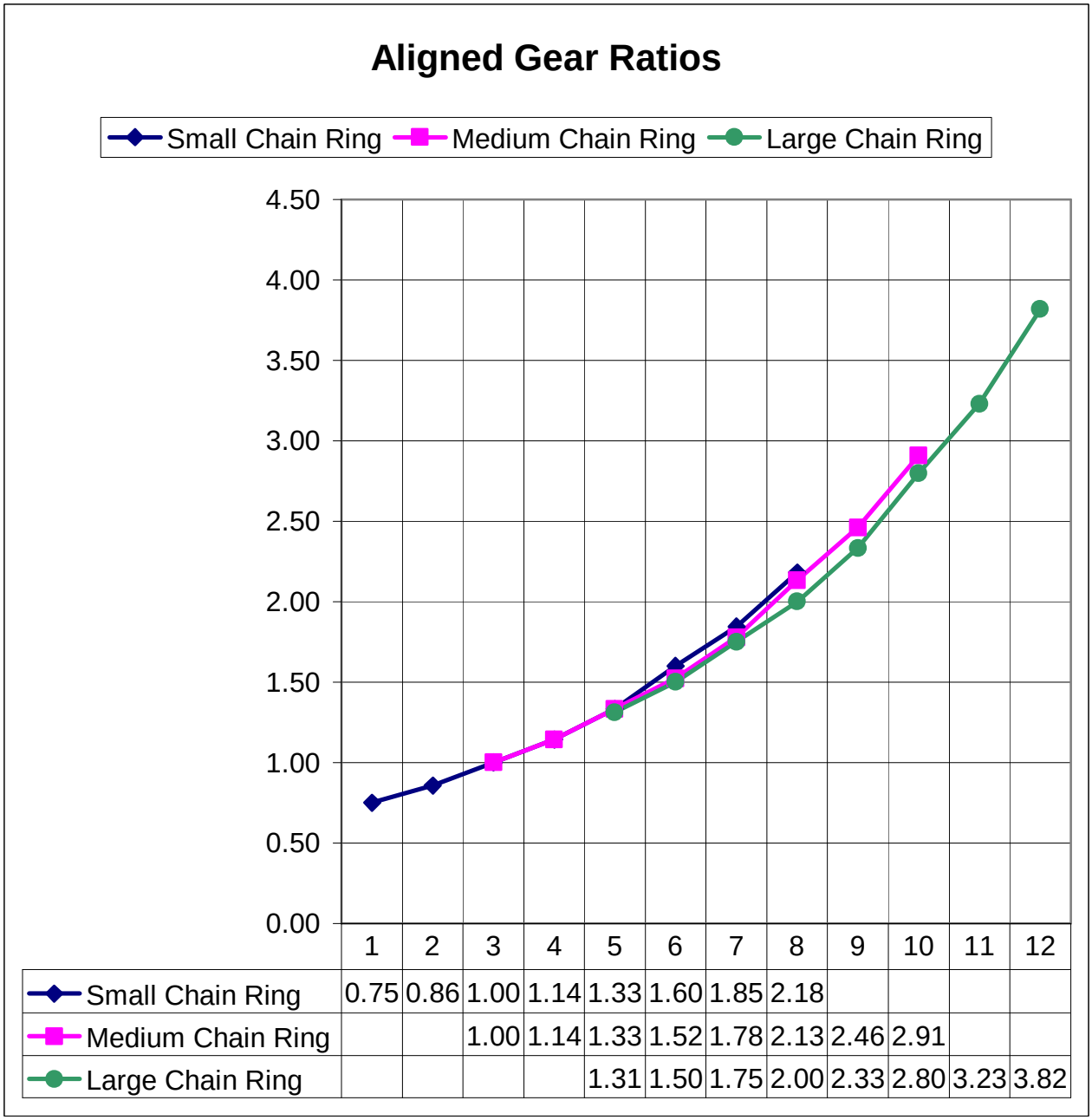
Chart 1



	1	2	3	4	5	6	7	8
Small Chain Ring	0.75	0.86	1.00	1.14	1.33	1.60	1.85	2.18
Medium Chain Ring	1.00	1.14	1.33	1.52	1.78	2.13	2.46	2.91
Large Chain Ring	1.31	1.50	1.75	2.00	2.33	2.80	3.23	3.82

Chart 2 illustrates the overlap of each range when these ranges are aligned by gear ratio. Notice how closely the gear ratios are clustered when the ranges are aligned.

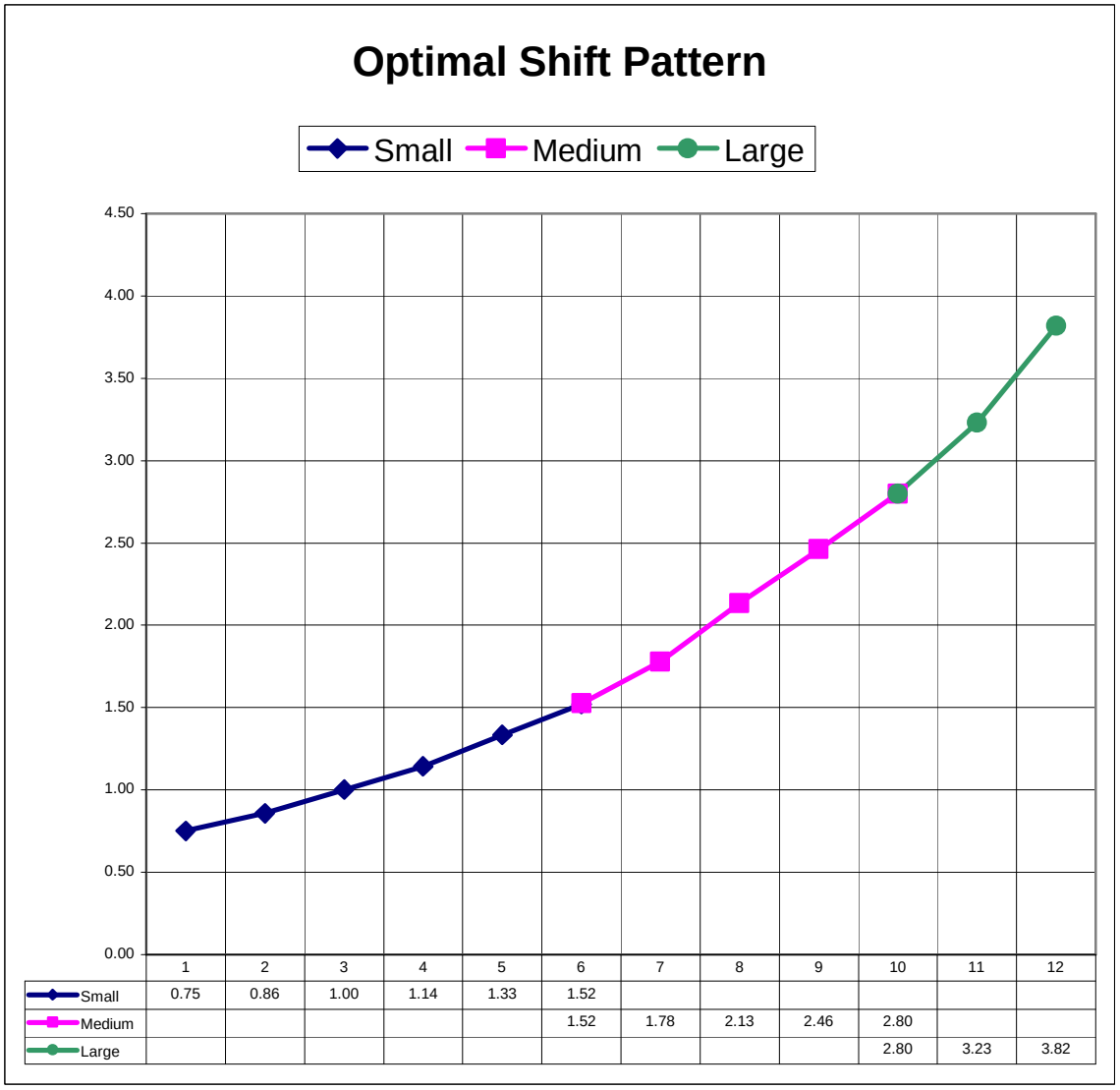
Chart 2



	1	2	3	4	5	6	7	8	9	10	11	12
Small Chain Ring	0.75	0.86	1.00	1.14	1.33	1.60	1.85	2.18				
Medium Chain Ring			1.00	1.14	1.33	1.52	1.78	2.13	2.46	2.91		
Large Chain Ring					1.31	1.50	1.75	2.00	2.33	2.80	3.23	3.82

When you eliminate all redundant gear ratios and select shift points that minimize the potential for cross chaining, the optimal shift pattern displayed in Chart 3 emerges. You can see from the curve on the graph that this optimal shift pattern changes gear ratio at as even a rate as possible.

Chart 3

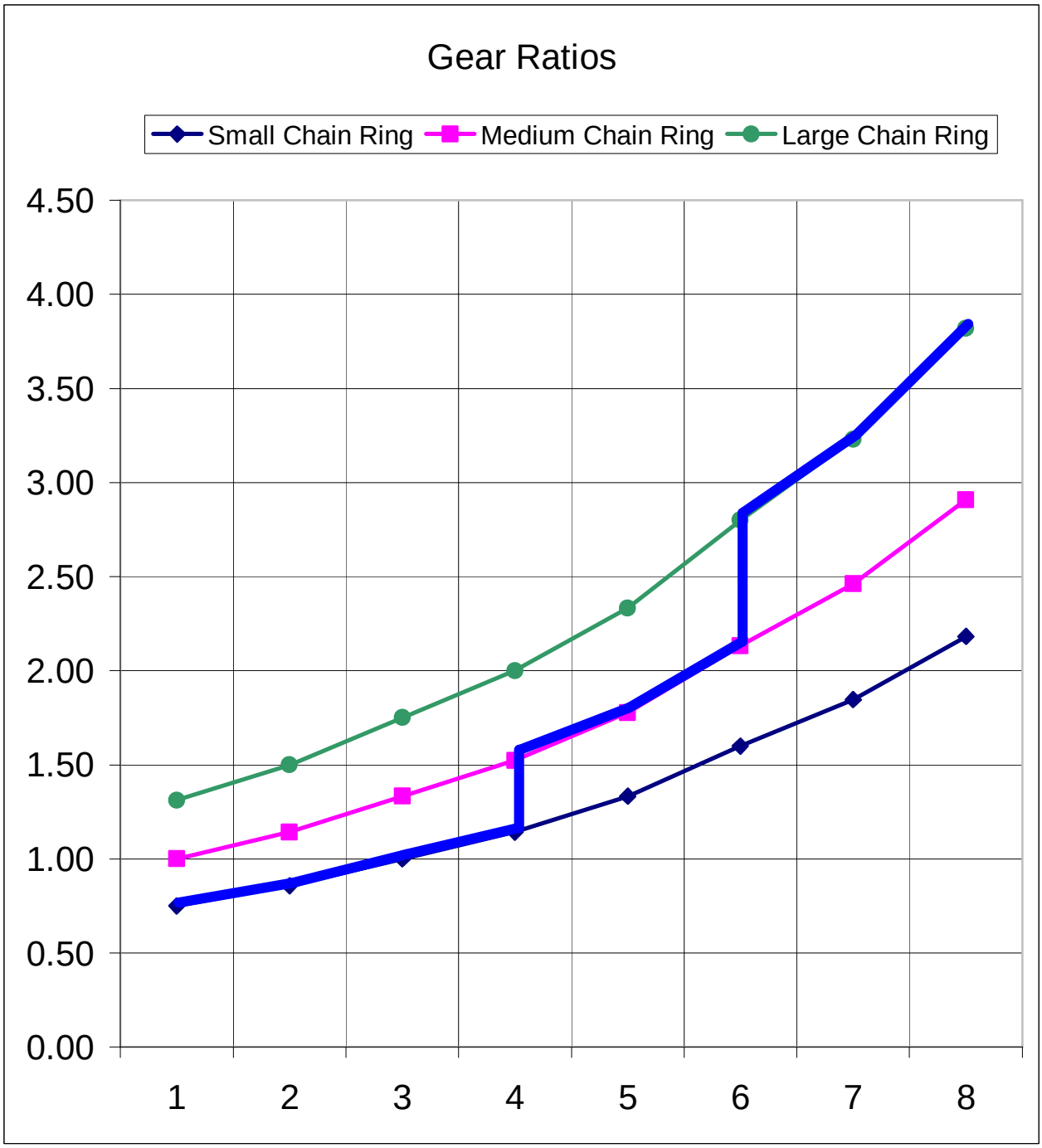


	1	2	3	4	5	6	7	8	9	10	11	12
Small	0.75	0.86	1.00	1.14	1.33	1.52						
Medium						1.52	1.78	2.13	2.46	2.80		
Large										2.80	3.23	3.82

Consequently when a front chain ring shift occurs with the optimal shift pattern, the changes in cadence and power output are indistinguishable from a rear derailleur shift because the change in gear ratio is approximately the same. However, when front

chain ring shifts with conventional shifters take place, the gear ratios change dramatically even if you shift to avoid cross chaining.

Chart 4



Cross Chaining

Table 1 shows an optimal shift pattern. The "Cross" value indicates cross chain gearing combinations. In general, the further away from the optimal gear combination (as indicated by the degree of shading), the worse the cross chain situation becomes.

Table 1

Gear Ratios

Rear cog	Small 24 tooth	Gear	Medium 32 tooth	Gear	Large 42 tooth	Gear
32	0.75	1st	1.00	Cross	1.31	Cross
28	0.86	2nd	1.14	Cross	1.50	Cross
24	1.00	3rd	1.33	Cross	1.75	Cross
21	1.14	4th	1.52	6th	2.00	Cross
18	1.33	5th	1.78	7th	2.33	Cross
15	1.60	Cross	2.13	8th	2.80	10th
13	1.85	Cross	2.46	9th	3.23	11th
11	2.18	Cross	2.91	Cross	3.82	12th

i-shifter Advantages

In addition to eliminating confusion and greatly simplifying shifting, the i-shifter ™ technology provides a number of other benefits. These include improved derailleur performance, reduced component wear and better chain retention. Since the i-shifter ™ only follows the optimal shift pattern which minimizes cross chaining, it does not require as wide a front derailleur cage as conventional shifters. A narrower front derailleur cage combined with a smaller gear ratio change results in crisper front derailleur shifts than what is possible with conventional front derailleur cages.

Following is a summary of the design and manufacturing features:

Design Features:

- Operational simplicity.
- Employs an indexed, optimal shift pattern.
- Easily adjusted and maintained by the user.
- Durable – All components are well protected from crash forces. Mounting allows for energy absorption at impact.
- Minimal size and weight.
- Ergonomically sound design
- Compatible with existing brake levers and bar ends.
- Single and multiple indexed gear changes upshifting and downshifting.
- Positive stops at either end of the gear range.
- Eliminates the need for gear indicators.

Manufacturing Features:

- Ease of manufacture – Most parts are injection molded using advanced high performance engineering resins. Shifting mechanism is die-cast metal.
- Designed for existing derailleur drivetrains.
- Ease of assembly – no bolts, internal springs or mechanical fasteners.
- Easy to maintain – Easily disassembled and reassembled. There are only 3 moving parts.