



## **Wireless Height Encoder**

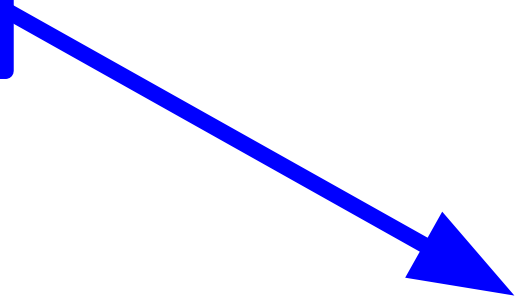
Hyster Yale Group

# Project Goals

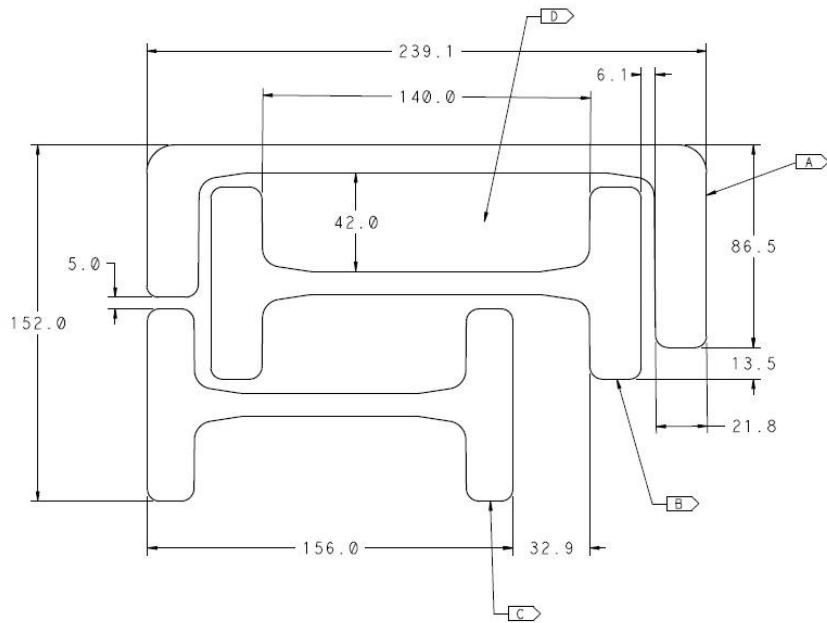
- **Wireless height measurement**
  - No power from forklift battery
  - No wire to return data to forklift
- **Energy harvesting**
  - Can recharge itself using energy from up/down motion
  - Alternative: can run three years on a single battery
- **Functional prototype only**
  - Final packaging is not within project scope
  - Programming to use acquired data not within project scope



Category	Metric No.	Need Nos.	Metric	Priority	Units	Marginal Value	Ideal Value
Function	1	1	Reference Frame	1		Mast	Ground
	2	2	Measurement System	1		Memory	Absolute
	3	5	Measurement Height	1	meters	4	7
	4	12	Time Between Calibrations	2	years	3	Infinity
	5	15	Maintenance Schedule	2	years	3	Infinity
	6	13	Production Cost	2	USD	150	500
Electronics	7	4	Battery Life	1	years	3	Infinity
	8	14	Connector Type	2		pigtail	deutch
	9	6	Measurement Resolution	2	mm	25	2
	10	8	Update Speed	2	Hz	32	400
Hardware	11	10	Sensor Volume	3	mm^3	127 x 127 x 25	64 x 90 x 18
	12	16	Durability	2		None	IP67
	13	9	Mounting Packages	3	packages	2	1
Basic Req'ts	14		Wireless Sensor	1			Required
	15		CANOpen Receiver	1			Required
	16		Patents	1			Doesn't Infringe
	17		Adaptability	3			Fits all trucks
		Key:	Necessary for prototype	1			
			Necessary for future product	2			
			Preferable for future product	3			



**Preferred Mounting Location**



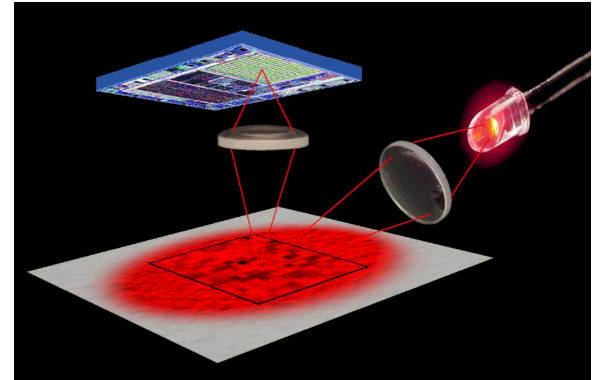
- A OUTER CHANNEL
- B INTERMEDIATE CHANNEL
- C INNER CHANNEL
- D SPACE BETWEEN OUTER AND INTERMEDIATE CHANNELS, POTENTIAL SENSOR LOCATION.

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GROUP		CHANGES FOR THIS REVISION	
REVISED			
MASS (REF)	kg		
SIMILAR TO			
MATERIAL SPECIFICATIONS			
UNLESS OTHERWISE SPEC'D DIMS ARE IN MM AND TOLERANCE ARE:		NAME	
1. WHOLE DIMS ±		MAST CHANNEL LAYOUT	
2. PLACE DIMS ±			
ANGLE DIMS ±			
SCALE	FIRST ANGLE PROJECTION	SHEET OF DRAWING NUMBER	0
1:1		1/1	0

A2 PROVE

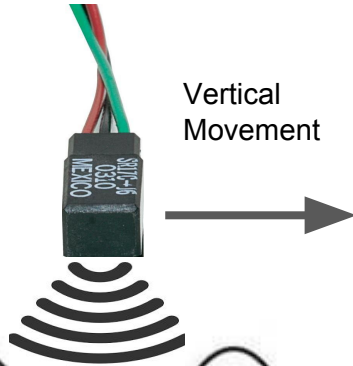
# Optical computer mouse

- Contains
  - a camera sensor
  - an LED or laser
  - a plastic lens
  - an image processor
- Optically measures movement of surface
- Laser mouse works on any surface condition
- Can track rapid movements
- Accurately measures small movements
- Larger movements = larger error
- May have trouble with hysteresis error



# Hall Effect Sensors

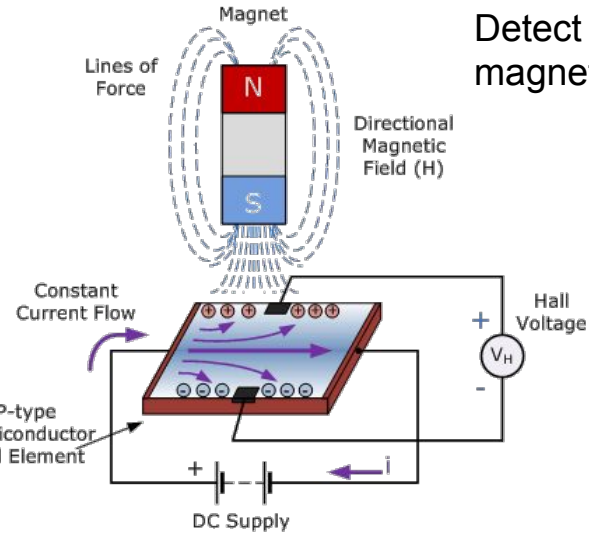
The sensor will count each chain link it passes and calculate its height based on the number of links



Magnetic Strength

Chain Links

Empty Space

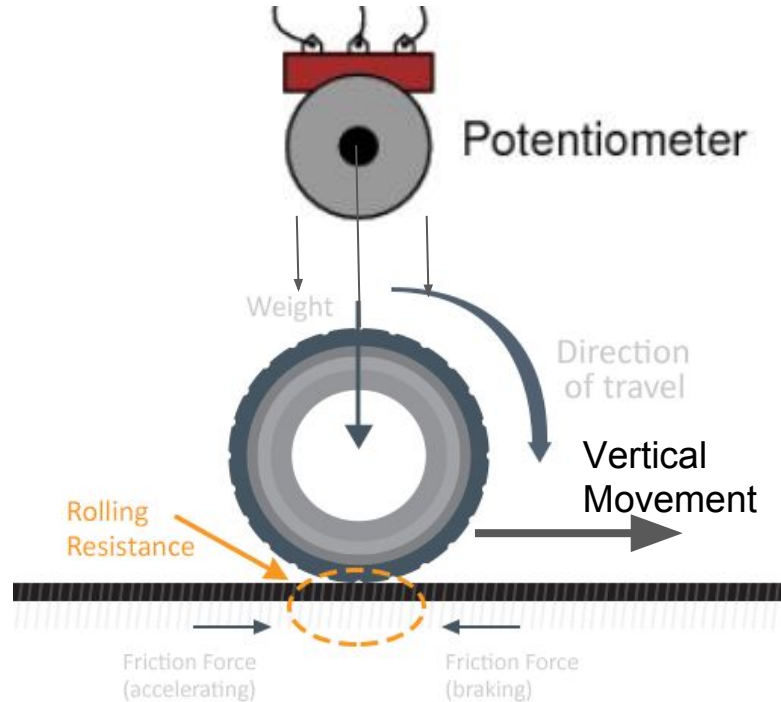


Detect the magnitude of magnetic fields

Pros: -No physical connection  
-Instantaneous response

Cons: -System would require a modular chain to be attached to the forklift channels  
  
-The system would need to store and update the memory of which link it is "on"

# Friction-Based Potentiometer



- Contains:
  - Rotary Potentiometer
  - High-Friction Tire
  - Mounting Bracket
- Tire rolls across vertical beam due to friction
- Potentiometer measures height by axis rotation
- Accurately measures large movements
- Small movements hard to track
- No calibration needed, just a memory system



# RF Distance Measurement

A distance measurement can be obtained by

- Timing the delay between sending and receiving the signal
  - The resolution of this is based on sampling rate
  - To meet the project requirements we would need a sampling rate of **6.7THz** (unattainable)
- Sending numerous frequencies and measuring the phase difference of the reflected waves
  - This requires a good reflecting surface, which cannot be counted on
  - There may be a way to implement this using two transceivers instead of a single transceiver and reflector.
- Adjust frequency to maintain a standing wave
  - Convert frequency to height
  - Will need a very good ADC with low power consumption.

