Evaluation of the ITRON Open Way AMI Meter

By William Bathgate, EE, ME

January 12, 2017

Note: This report has been written in terms that a common person with limited knowledge of electricity and engineering can understand.

About the Author

BACKGROUND: William S. Bathgate

I hold an electrical engineering and mechanical engineering degree and previously was employed through late 2015 for 8 years at the Emerson Electric Company. While at Emerson Electric I was the Senior Program Manager for Power Distribution Systems and in charge of RF and IP based digitally controlled high power AC power switching system product lines in use in over 100 countries. I was also directly responsible for product certifications such as UL, CE, PSE and many other countries electrical certification bodies. I am very familiar with the electrical and electronic design of the AMI meters in use because I was responsible for very similar products with over 1 Million units installed across the world.

I hold a DOD Top Secret Clearance, serving in Cyber Security at the USMDA and Homeland Security

I have done this analysis due to my own curiosity without conflict of interest of this new technology.

I have 40 Years work experience in design and deployment of:

- High tech power management systems, UPS and power distribution
- Switched Mode Power Supplies
- Electrical and Electronic hardware engineering
- Computer systems engineering
- Radio Systems design and testing
- High Current and High Voltage switches
- Internet communications using both wired and wireless technologies
- UL, CE (Europe), Africa, Japan, Australia and China product safety certifications
- Cyber encryption and protection of Radio Communications using digital signals
- RFI/EMI mitigation

Agenda

Part 1 - Basic Engineering of the AMI meter

- **The Opt-Out Meter and its differences from the AMI "Smart Meter"**
- **The Switched Mode Power Supply (SMPS) which converts 240 Volts AC to the various low voltage DC power sources for the electronics**
- **Electrical principles and proper SMPS design characteristics**
- **"Dirty Electricity"**
- **The Common Mode Filter and how it protects against "Dirty Electricity"**

Part 2 – ITRON Meter construction and design

- **The SMPS board and characteristics and Power Sensing "Hall Effect" sensors**
- **The Power Disconnect up close, size of the contacts and ratings**
- **The Metrology System board, LCD placement, back up battery, Power Disconnect point**
- **The "Brains" of the meter and the two radio transceivers**

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Part 3 – Power Measurement and accuracy, design summary

- **The radio transmission, frequency and signal encryption**
- **Privacy and Vulnerability to hacking**
- **The cost in kWh to run the meter, you pay to run the meter**
- **Meter accuracy and your bill**
- **Expected life of the Meter**
- **Overall observations and weak design areas of the Meter**
- **Has the investment in new AMI meters benefited the consumer?**

Agenda – Part 1

Part 1 - Basic Engineering of the AMI meter

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- **"Dirty Electricity"**
- **The Common Mode Filter and how it protects against "Dirty Electricity"**

Advanced Meter Infrastructure (AMI) Meters and their Switched Mode Power Supply (SMPS)

AMI Meter

Not UL Approved

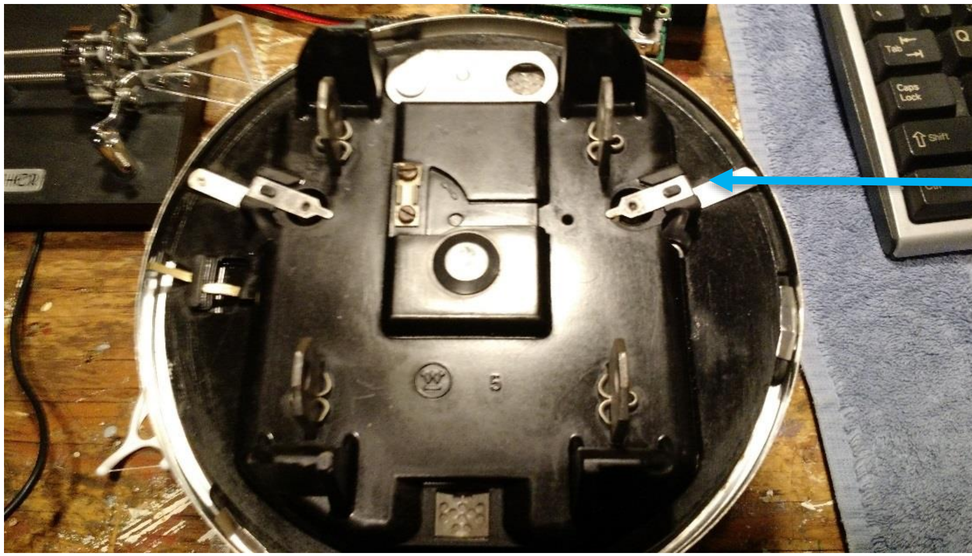
Analog Meter

UL Approved

- What is the AMI Meter?

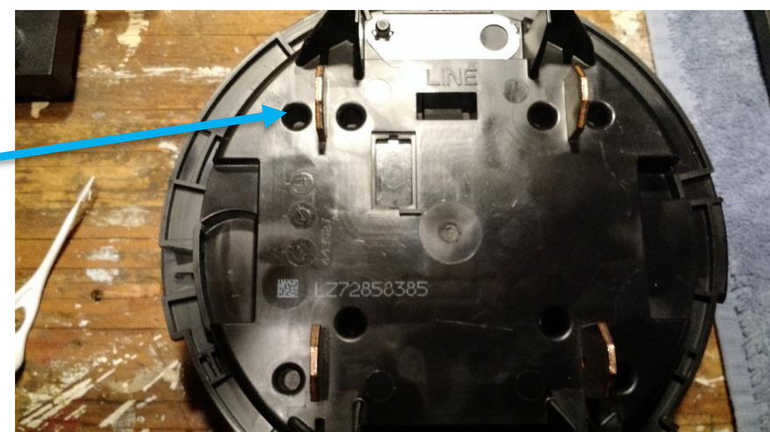
  - The AMI meter is commonly called a “Smart” meter and is the end point of a Smart Grid infrastructure attached to your house. The AMI end point is not required for a Smart Grid to exist. In fact the Smart Grid will take over two decades to fully deploy, but the utilities decided to deploy the AMI Meters based on incentives and payments from the Federal Government included in the Community Re-Investment Act of 2009. The useful life of the AMI meter is 5-7 years and needs to be replaced due to the aging of the electronic components. At that point all the costs will be born by the utilities and will be recompensed by the consumer in the form of higher rates. The older Analog meters which the AMI replaced are still available and have a useful life of 30-50 years and had no electronic circuits.

What is missing on the AMI Meter?



Analog Meter - Surge Suppression tabs which allows any power surge or lightning strike to safely route to earth ground

AMI Meter - Surge Suppression is not present, therefore any power surge or lightning strike will route to the electronics boards and cause an explosion and likely a fire.



Advanced Meter Infrastructure (AMI) Meters and their Switched Mode Power Supply (SMPS)

AMI Meter

Analog Meter

- Each AMI meter has three electronic circuit boards and a pair of radio transceivers. In order to power the electronics and radios it requires a conversion of the 240 Volts AC power feed to lower voltage DC current via a Switched Mode Power Supply (SMPS). A SMPS is very efficient, is lower in cost and weight and have replaced the older linear power supplies that had been in use in the past.
  - You likely have several SMPS in your home in your TV's, Stereos, Phone Chargers and many other electronic devices you own. Many of these devices have been tested to very stringent UL Home Use standards, some have not. The devices that do not meet the home appliance UL standards (cheaply made grow lights as an example) inject high frequency oscillations back onto the power line, which radiate through all the power wires in the home like a thousand foot long antenna, these cause human health issues and equipment failures to downstream appliances and circuits. The AMI's SMPS is the type of design that injects high frequency oscillations on the power line entering your home. There is a UL standard for AMI metering but it is very different from the Home Appliance UL standard and does not address the AMI SMPS characteristics. The ITRON AMI Open Way meter does not currently meet any UL standards at all, ITRON says It does not need to because it is not a home device, really?

SMPS with Common Mode Filter – Principles You Need to Understand

- What you need to know about the effects of applying electrical and magnetic principles

  - A SMPS utilizes a switching semiconductor (electronic chip) circuit to reduce the overall size and weight of the power supply and improves efficiency. This chip has other components that limit the amount of voltage rise in the switching circuit, these are called capacitors and can be in either cylindrical in shape, a flat or box shape. There are many other parts but these are the key components.

  - A SMPS works similarly as if you were to turn your light switch on and off at a very high frequency. The amount of voltage reaching the light would be reduced to a fraction of its full voltage illumination making the light dim. You could do the same thing with a very large resistor, but that resistor would get extremely hot very quickly, consume large amperages and waste power.

SMPS with Common Mode Filter – Principles You Need to Understand

- What you need to know about the effects of applying electrical and magnetic principles
  - Whenever you switch electricity between on and off you create an electrical spike in the electrical signal that looks like a saw tooth shape waveform on an oscilloscope, this creates RF noise (static) and magnetic effects, these are called EMI/RFI leading to dirty electricity.
  - When you place a voltmeter into an common house outlet the volt meter is providing an RMS measurement. RMS is an abbreviation of the term “Root Mean Square”. The actual peak voltage of a common house 115-120 volt AC cycle is about 177 volts. The RMS voltage is 120 volts. Never grab a house circuit with your hands, it will kill you because you are not be able to let go of the wires, because your muscles contract and the current will not let you release yourself. Then you go in heart seizure, this is very deadly.

SMPS with Common Mode Filter – Health Effects You Need to Understand

- This report is not meant to be a comprehensive review of the health effects from the oscillations present in a SMPS such as the AMI's oscillations in the form of "Dirty Electricity", but here are some important issues.

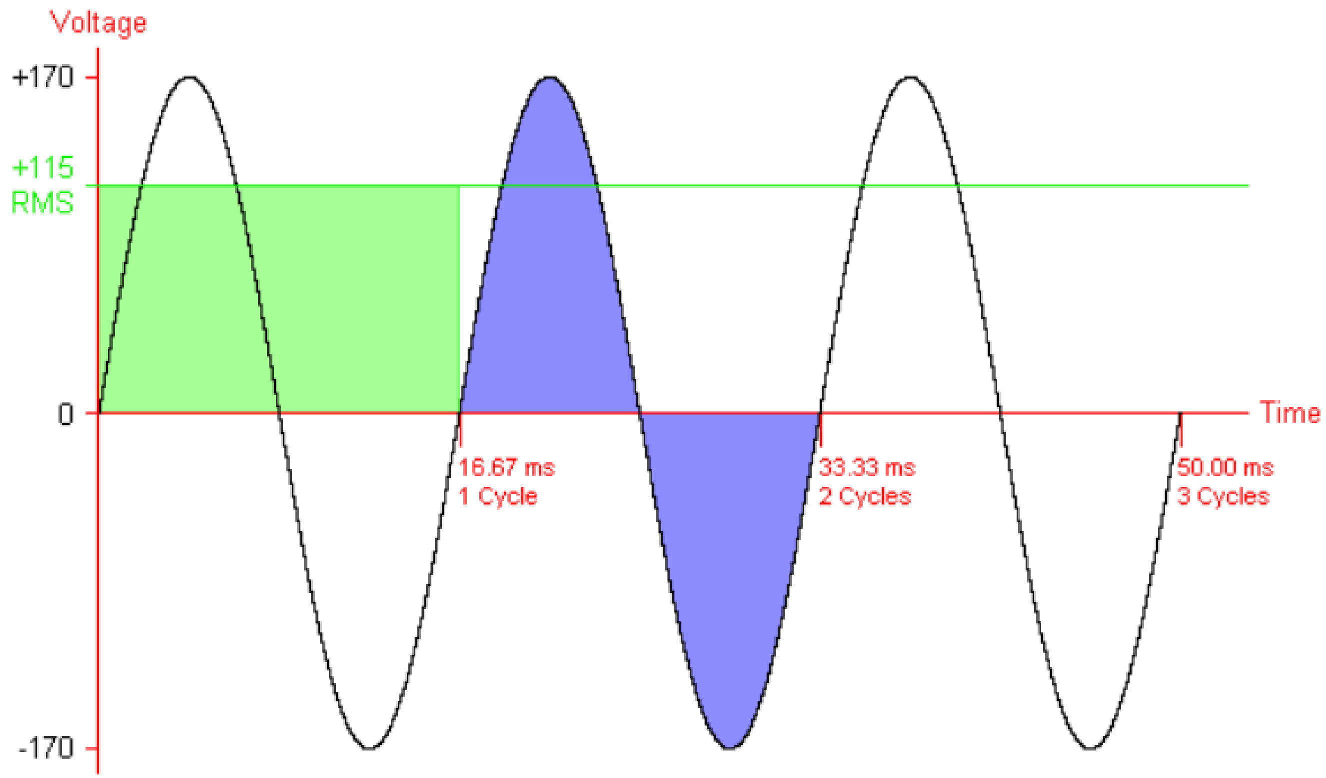
  - In August 2010, in a spectacular announcement that got very little coverage, noted epidemiologist, Samuel Milham, MD linked the growth of electrification and the incidence of four of the big six diseases. In his book "Dirty Electricity: Electrification and the Diseases of Civilization." Dr. Milham connects *dirty electricity* with heart disease, cancer, diabetes, neurological disorders like ALS and suicide. See http://www.electricsense.com/5229/dirty-electricity-electrification-and-the-diseases-of-civilization/

  - This report is not to comment on the radio emissions of the AMI meter except to say there is a lot of research and reports with the most alarming one on low level radiation direct link to cancer in the same 900 MHz frequency range used by the AMI meter and cell phones. The difference is that the cell phone can be turned off, while the AMI meter never goes off and it is on every home on the street creating a "Radio Soup" environment you cannot get away from.

    The National Toxicology Report found here at http://biorxiv.org/content/early/2016/06/23/055699.full.pdf+html

SMPS with Common Mode Filter – Principles You Need to Understand

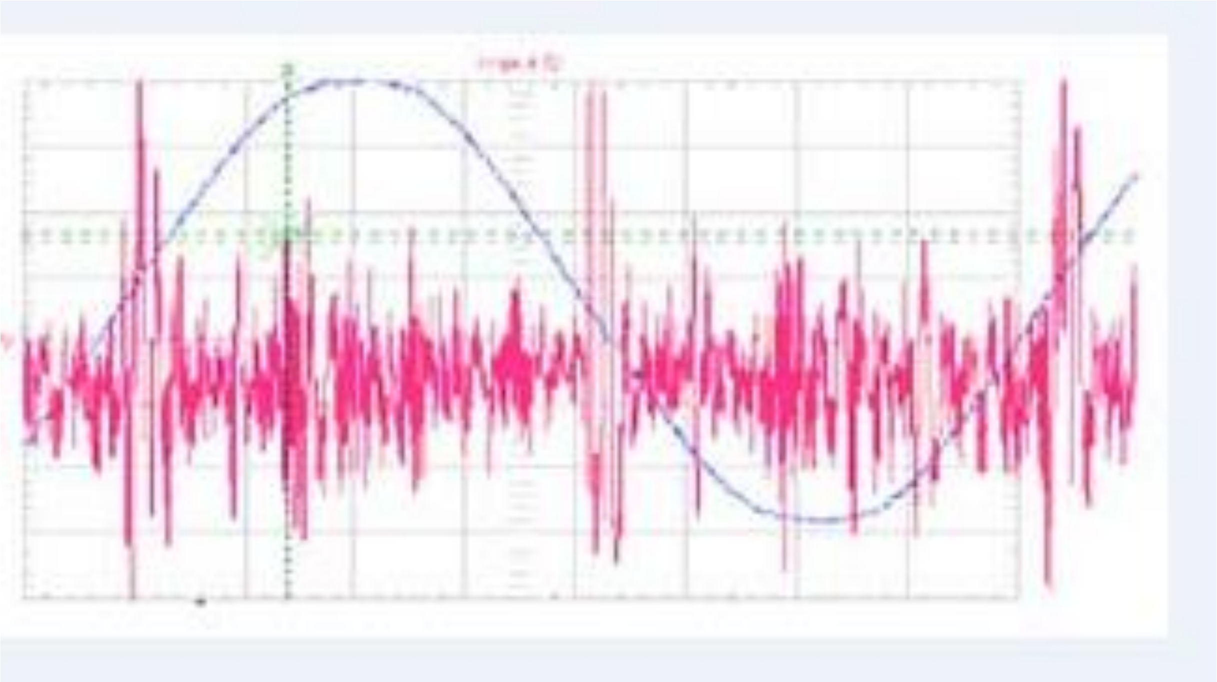
The Standard Single Phase 60 Cycle/Second 115 -120 Volt AC Power Oscillation Waveform



This waveform displayed is the same as an oscilloscope trace would look like, you cannot see this on a common voltmeter you would only see the reading of 115-120 volts RMS

SMPS with Common Mode Filter – Principles You Need to Understand

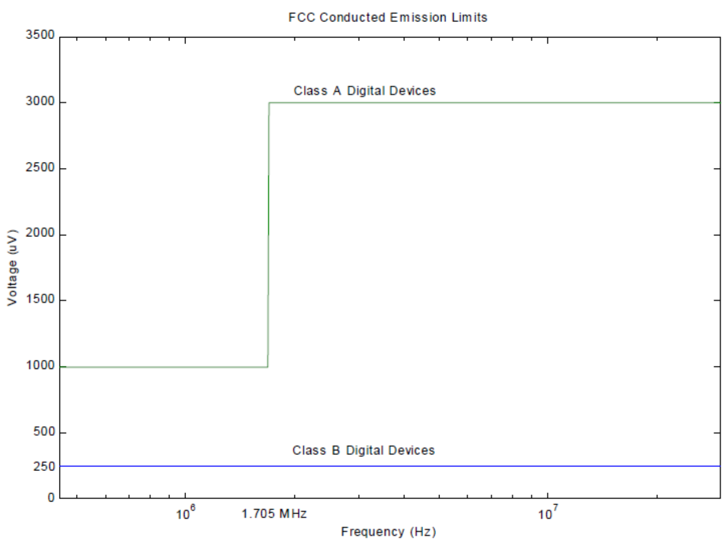
The Standard Single Phase 60 Cycle/Second Waveform with EMI/RFI introduced by the SMPS

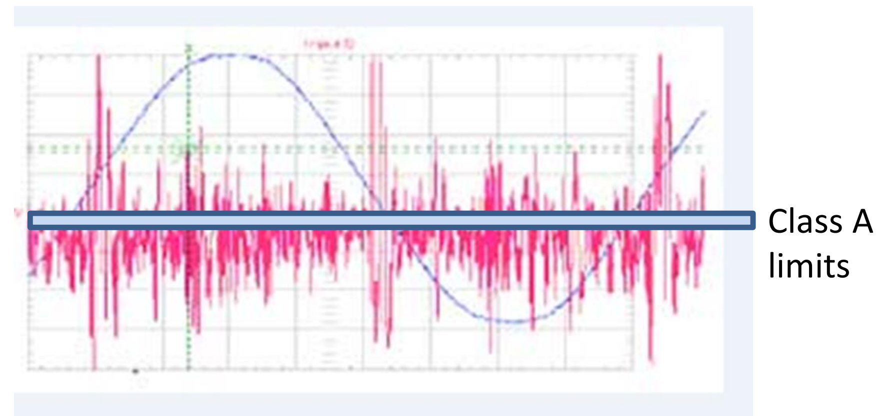


This waveform displayed is the same as an oscilloscope trace would look like, you cannot see this on a common voltmeter. Now we have introduced the effects of EMI/RFI via the SMPS to the same wire carrying the house current. This effect can be better depending on the environment especially how good the house earth ground is magnetically coupling the house voltage currents. There are many variables that affect this waveform. The image in red should never be there, I have found this pattern consistent with every AMI meter, including the AMI meter with the radios and all “digital” meters. It is not compliant to FCC rules for “conducted” Emissions Class A or Class B

SMPS with Common Mode Filter – Principles You Need to Understand

The Standard Single Phase 60 Cycle/Second Waveform with EMI/RFI introduced by the SMPS

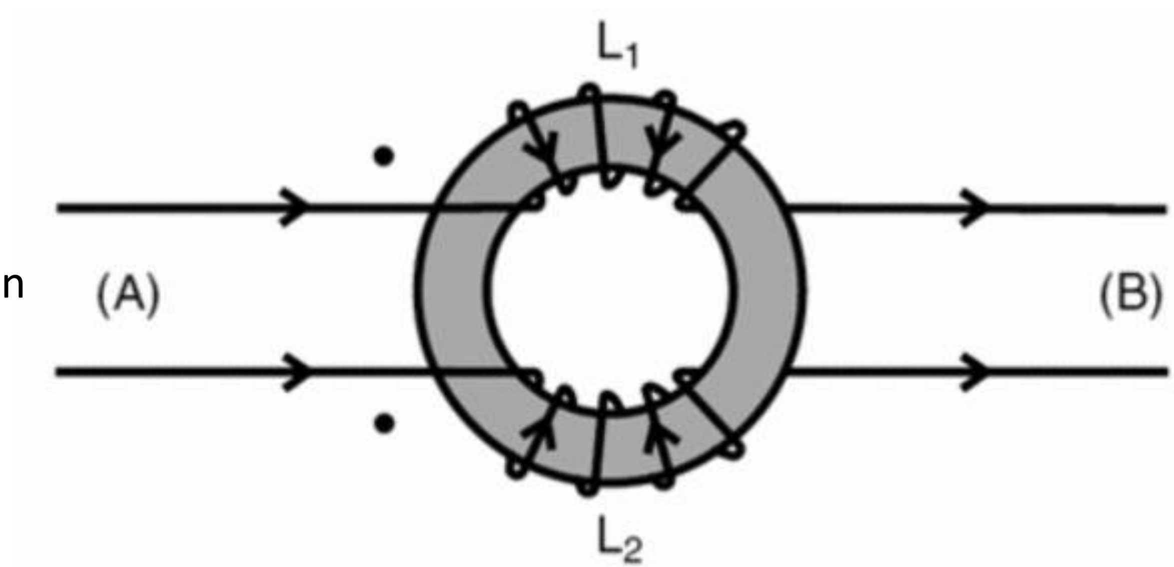




The image in red is for both AMI meters with the radios on/off. It is not compliant to FCC rules for "conducted" Emissions Class A or Class B. Shown here are the limits for CONDUCTED emissions not Radio Emissions which is a different specification, which are being fed back into the home wiring at the load panel. This is placing stress on all electronics and electric motors in the home, causing early appliance motor failures, appliance electronic control failures and radio interference in addition to health effects such as insomnia, tinnitus, headaches, blood sugar levels and nervous disorders such as neuropathy and heart rhythm. In order to become compliant the meter manufactured would have scrap the current SMPS design, and include one that connects to a earth ground path.

SMPS/EMI/RFI with Common Mode Filter - Example

240 Volts AC In

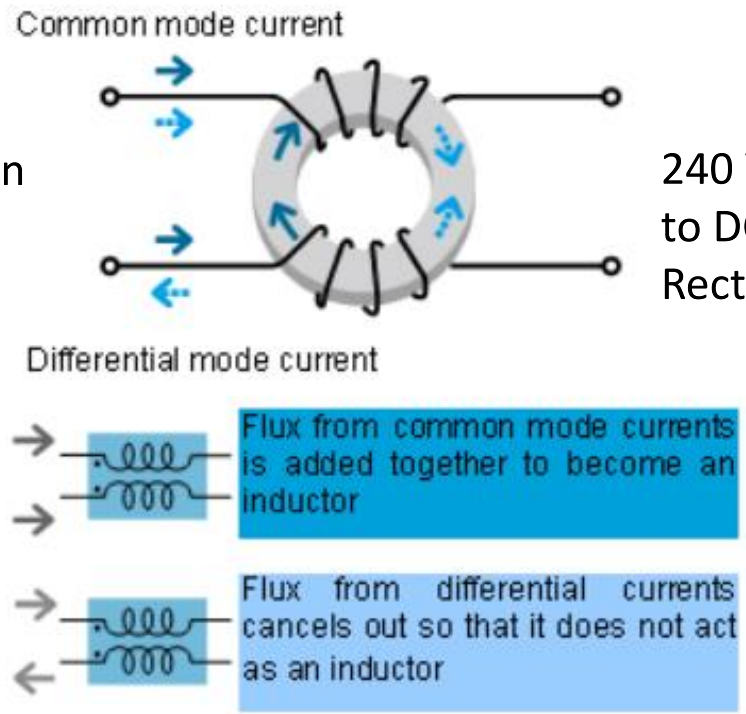


240 Volts AC Out

Please note the magnetic component is made of compressed iron ferrite and is shown here is a donut shaped image just to simplify the representation, but this can be accomplished via a magnetic shaped bar also and does the same thing. The number of windings on the donut are the same on both sides. It is a type of device called a choke filter.

SMPS/EMI/RFI with Common Mode Filter - Example

240 Volts AC In



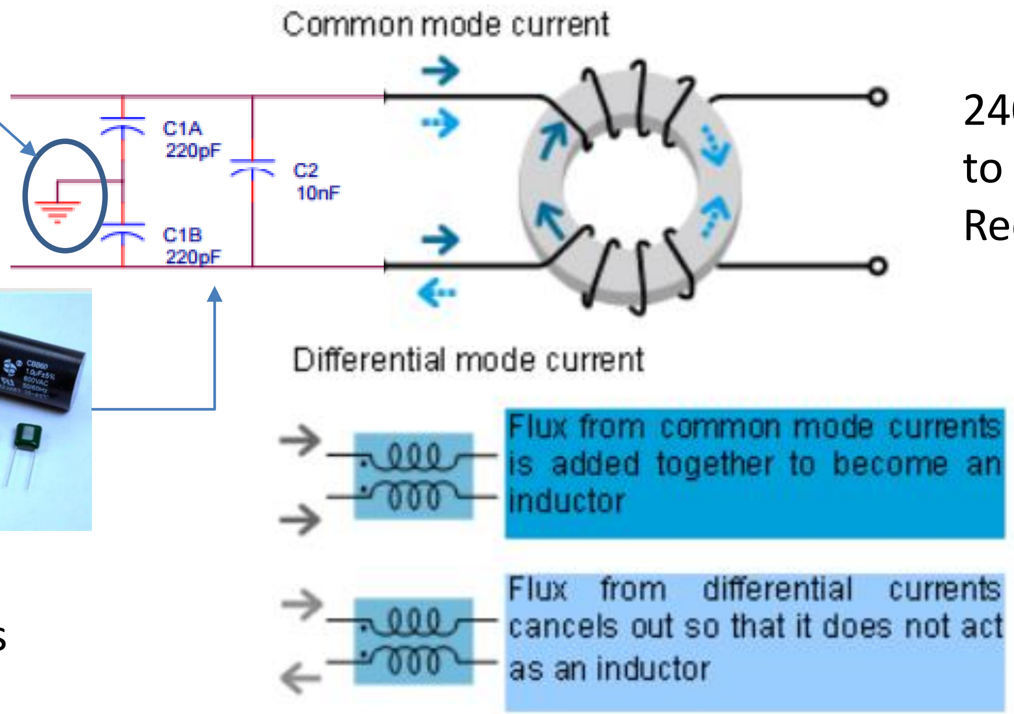
240 Volts AC out to the AC to DC converter or “Bridge Rectifier”

In this simplified representation it is very important to note that AC current flows in and out, it is bi-directional. Therefore any oscillations created by the switching circuit cancel each other out via counter acting magnetic flux within the ferrite core. There are added capacitors typically included but for simplification this diagram explains the fundamentals

SMPS/EMI/RFI with Common Mode Filter and Filter Capacitors added

Earth Ground

240 Volts AC In

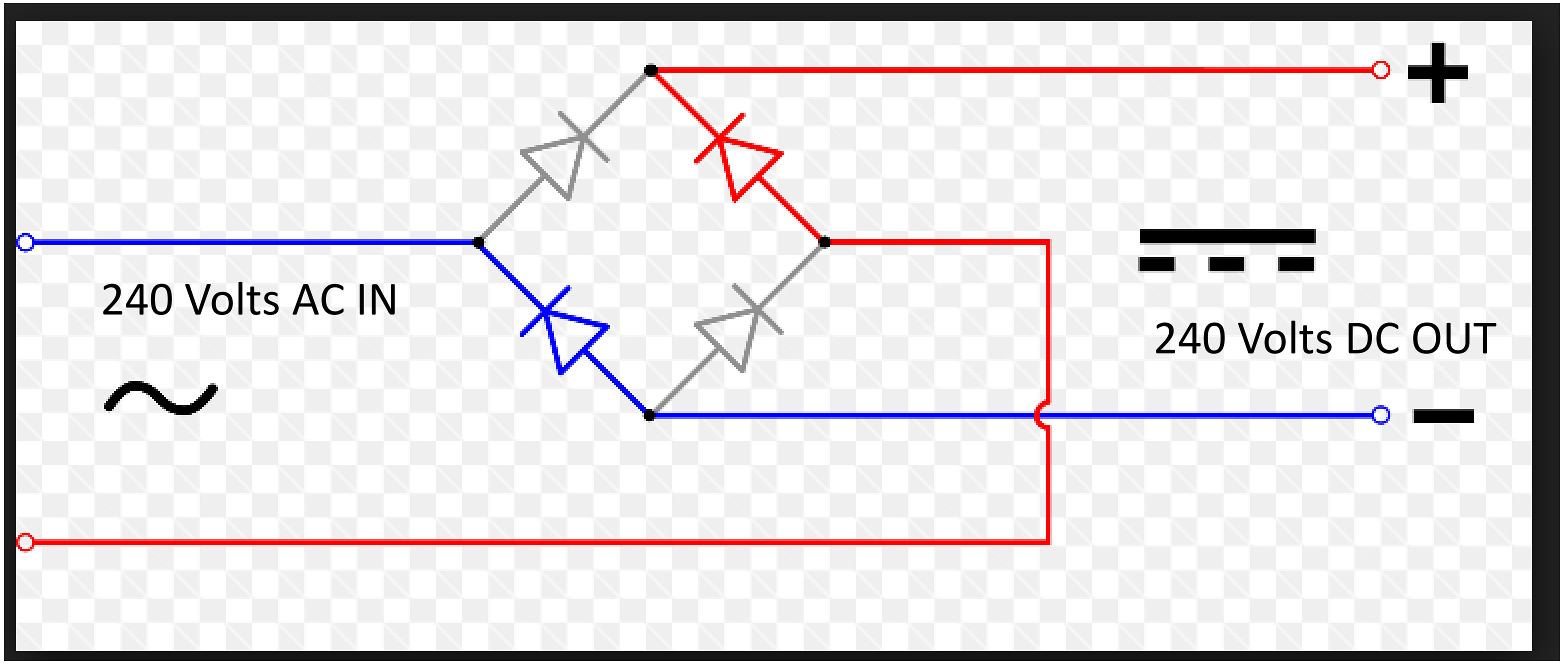


240 Volts AC out to the AC to DC converter or "Bridge Rectifier"

Typical Capacitors

In this representation you now have added the additional Filter Capacitors to "Clip" the frequency oscillations, you will note that for this to work there needs to be a ground connection as shown. The AMI meter does not have a connection to ground and therefore cannot be made safe to meet the FCC Conductive Emissions Standard

SMPS with Common Mode Filter – Example – AC to DC Converter



In this representation it demonstrates how you turn AC voltage into DC voltage  this is called a diode bridge and only allows one way flow similar to a check valve in plumbing you need 4 of them and it is termed as a "Bridge Rectifier"

SMPS with Common Mode Filter - Example

Ferrite core

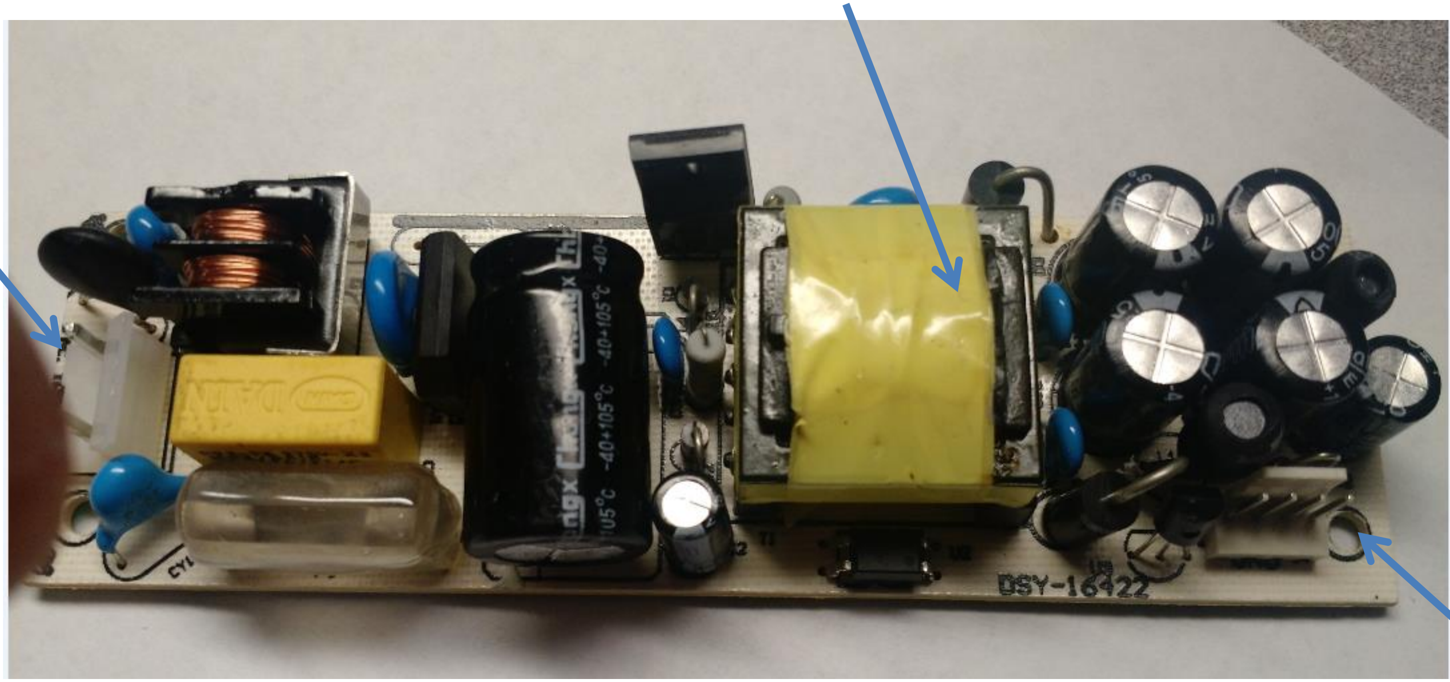
Here is an example of a common mode filter that does the same job as a donut shaped filter, here the ferrite core is in the center of the coils and is shaped as a square bar. This part cost $0.73 per piece in lots of 1,000

SMPS with Common Mode Filter – UL Approved Example

Please note this is an example of a UL approved 240 Volt AC to 24 Volt DC SMPS
This design does not inject high frequency oscillations onto the incoming AC line because it has a common mode filter circuit (left hand side of the circuit board)

Transformer that converts 240 volts to 24 volts

AC In

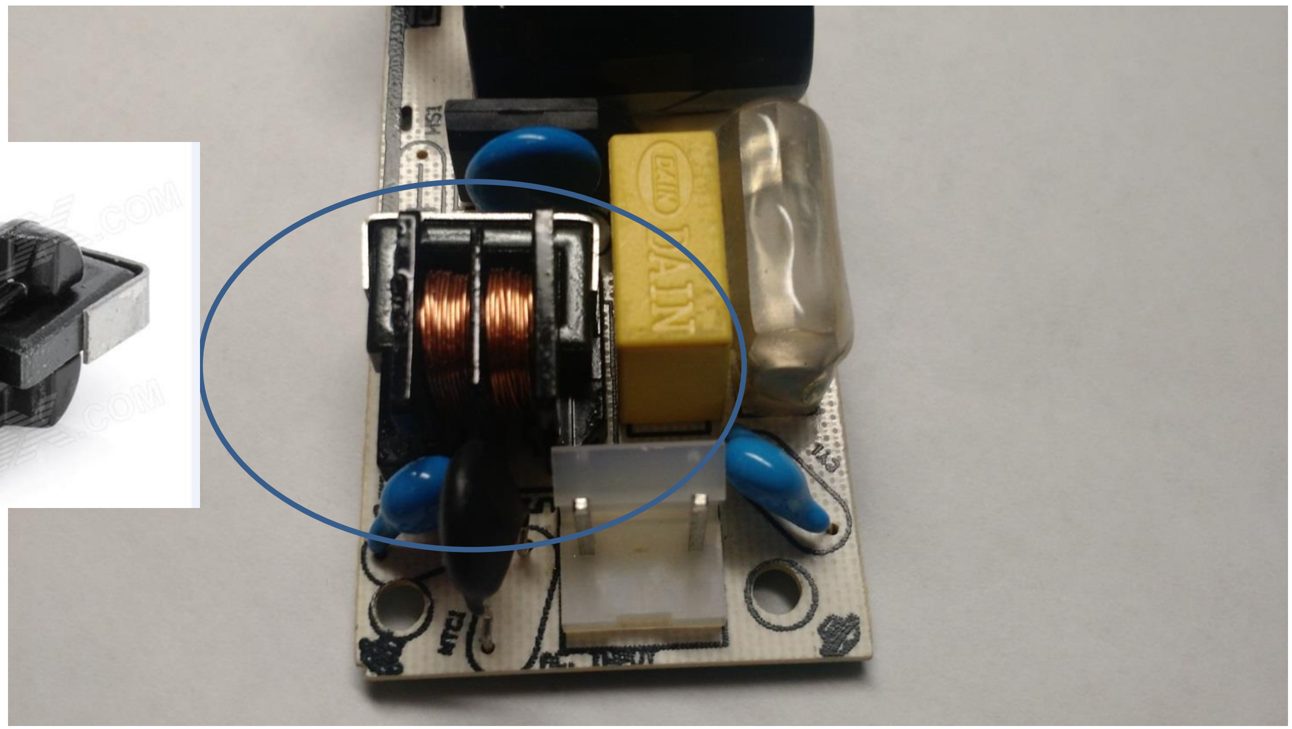


DC Out

Note the DC Out has + - and a ground lead (center) which is connected to a true ground

Common Mode Filter - Sample

Please note this is an example of the Common Mode Filter in the design example



Agenda – Part 2

Part 2 – ITRON Meter construction and design

- **The SMPS board and characteristics and Power Sensing "Hall Effect" sensors**
- **The Power Disconnect up close, size of the contacts and ratings**
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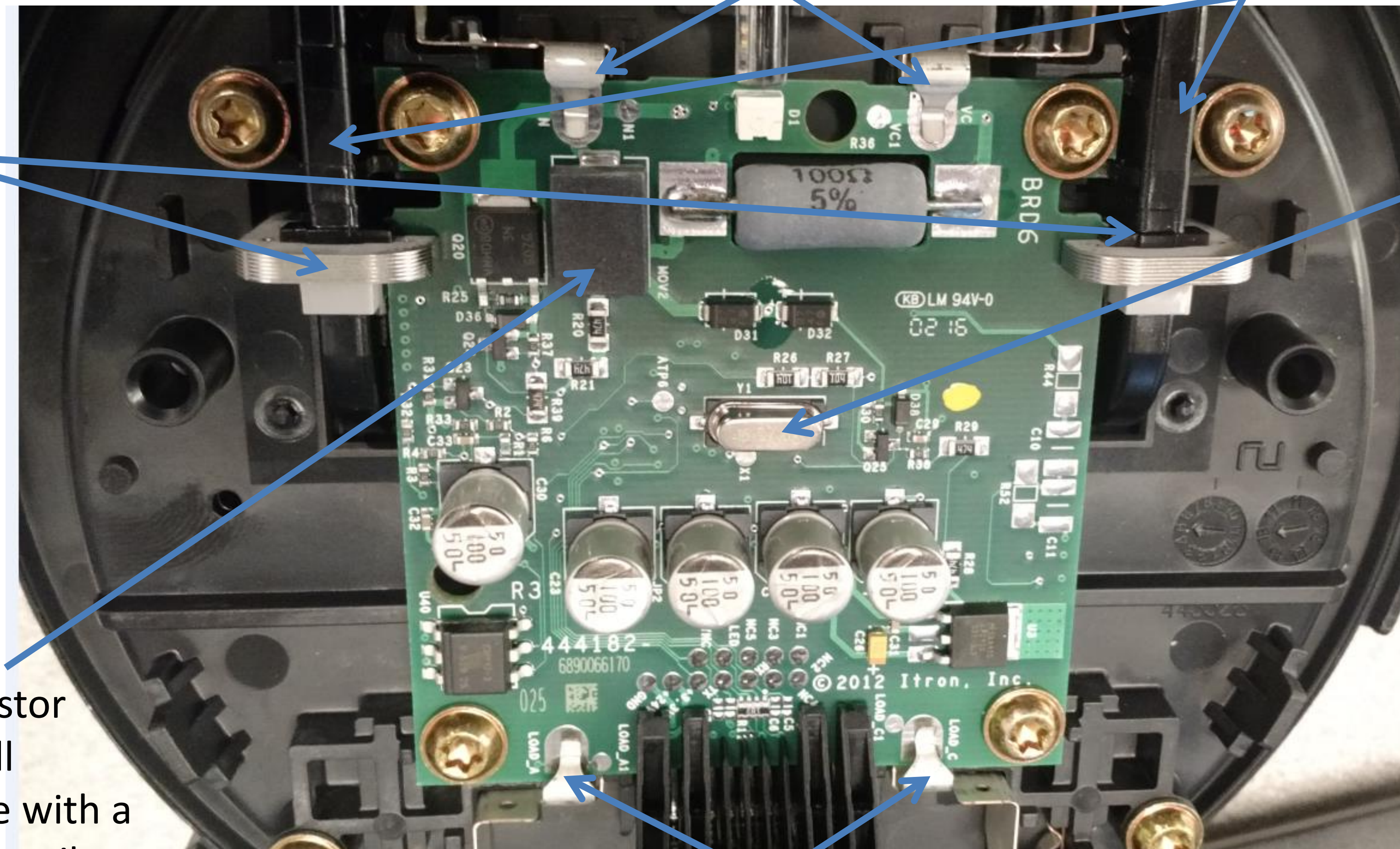
The ITRON Meter SMPS Board

240 Volts IN

Note under this plastic is the current carrying tab, if this gets hot it melts

Current – KW measurement

16 MHz Oscillator

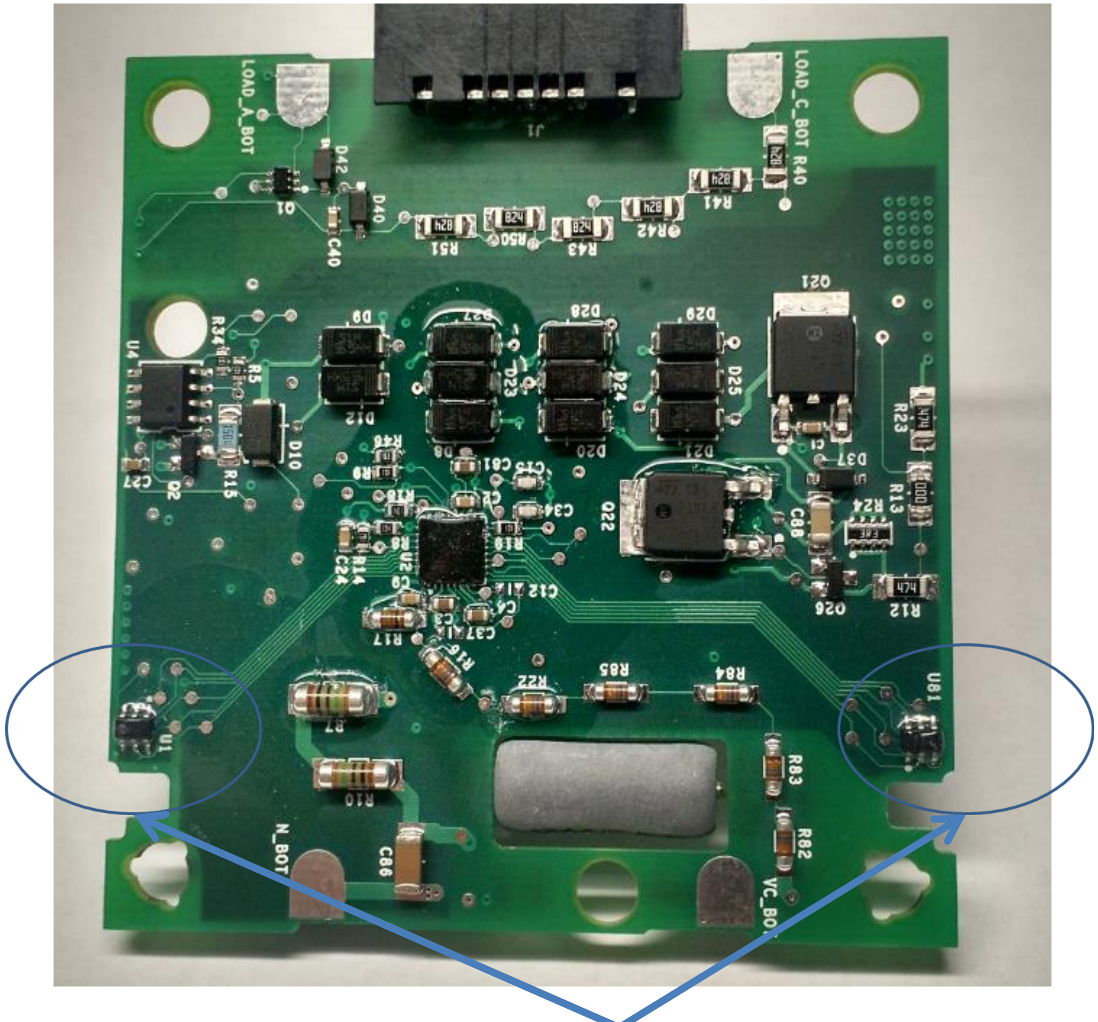


Thermistor that will explode with a lighting strike or power surge

240 Volts OUT

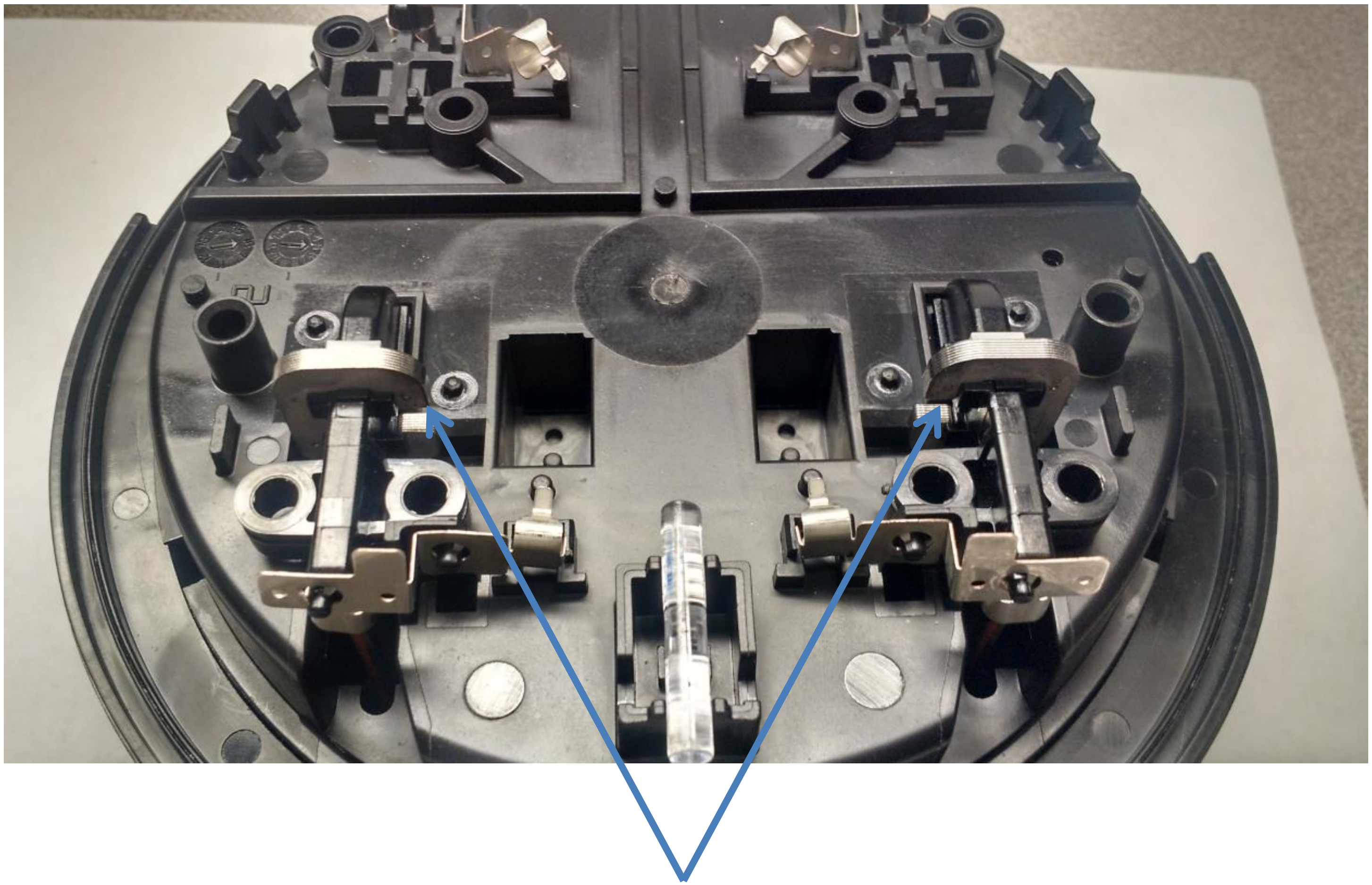
You will notice that there is no common mode filter circuit at all

The ITRON Meter SMPS Board – Back Side of Board



Here are the hall effect sensors that are used to measure Current/kWh

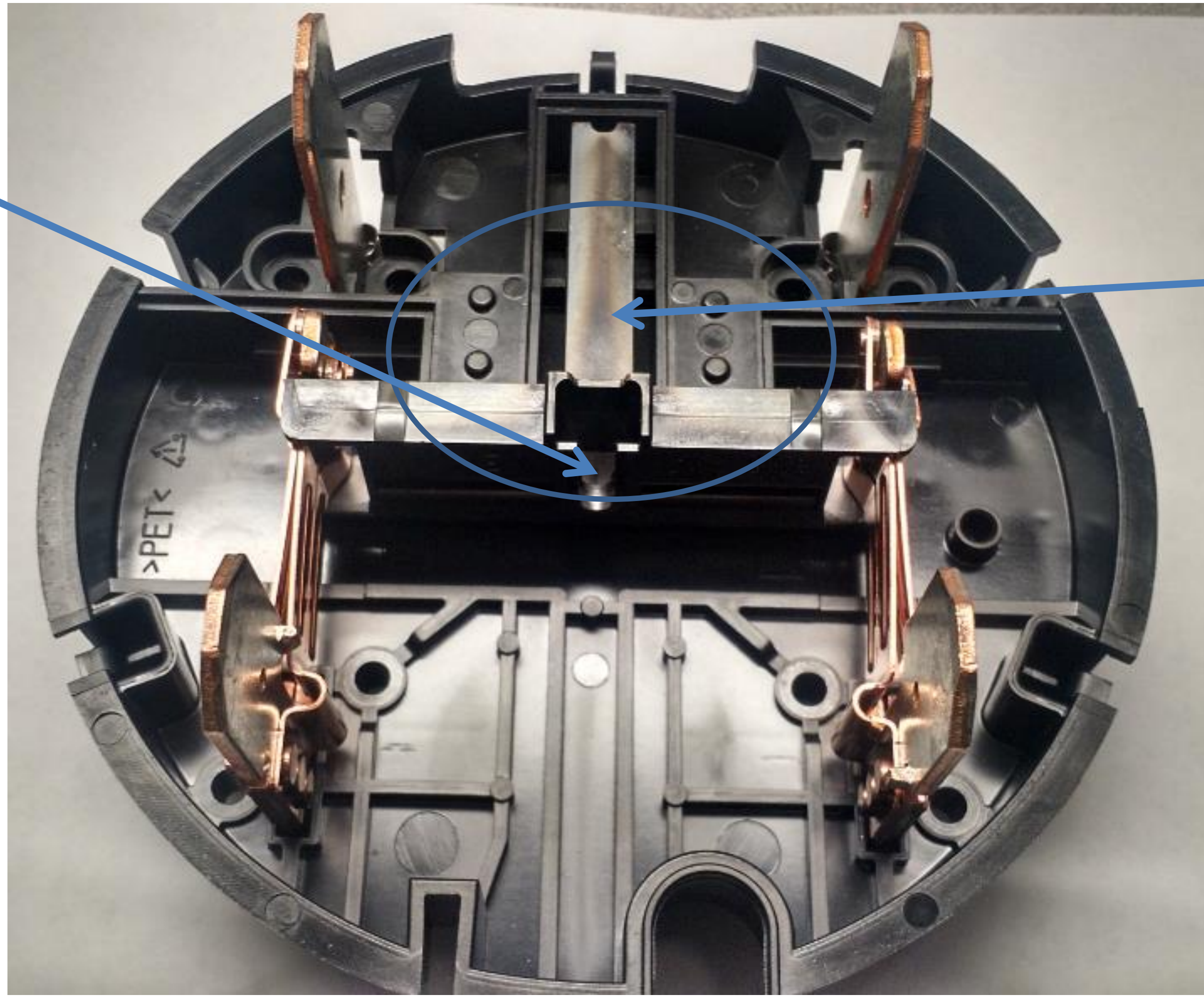
The ITRON Meter SMPS Board – Mounting Location



Here are where the hall effect sensors that are used to measure Current/KW are placed

The ITRON Meter Power Disconnect

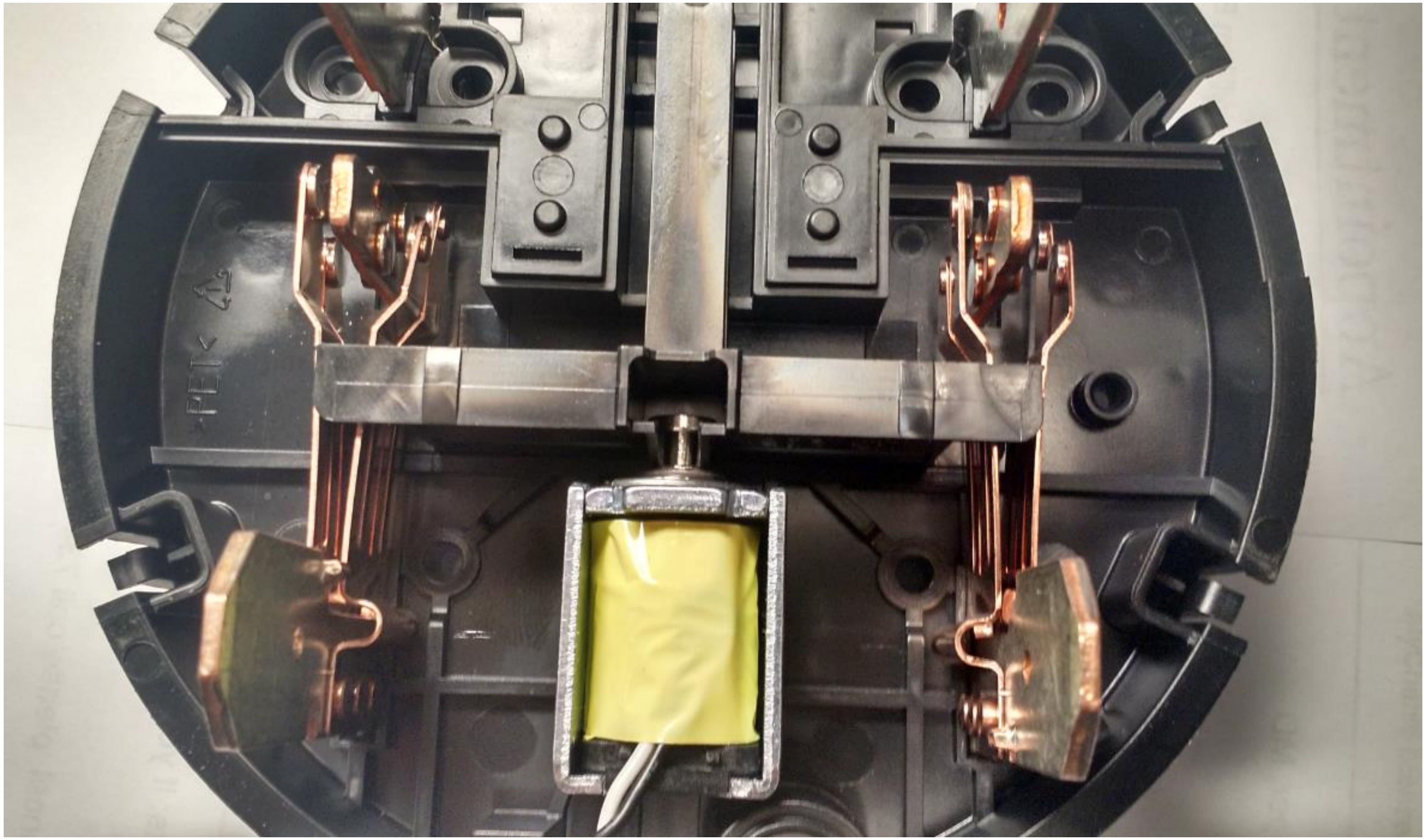
24 Volt Power Disconnect Solenoid



If you slide this plastic lever (with the notch in it) you break the contacts and shut off your power

The ITRON Meter Power Disconnect

24 Volt
Power
Disconnect
Solenoid



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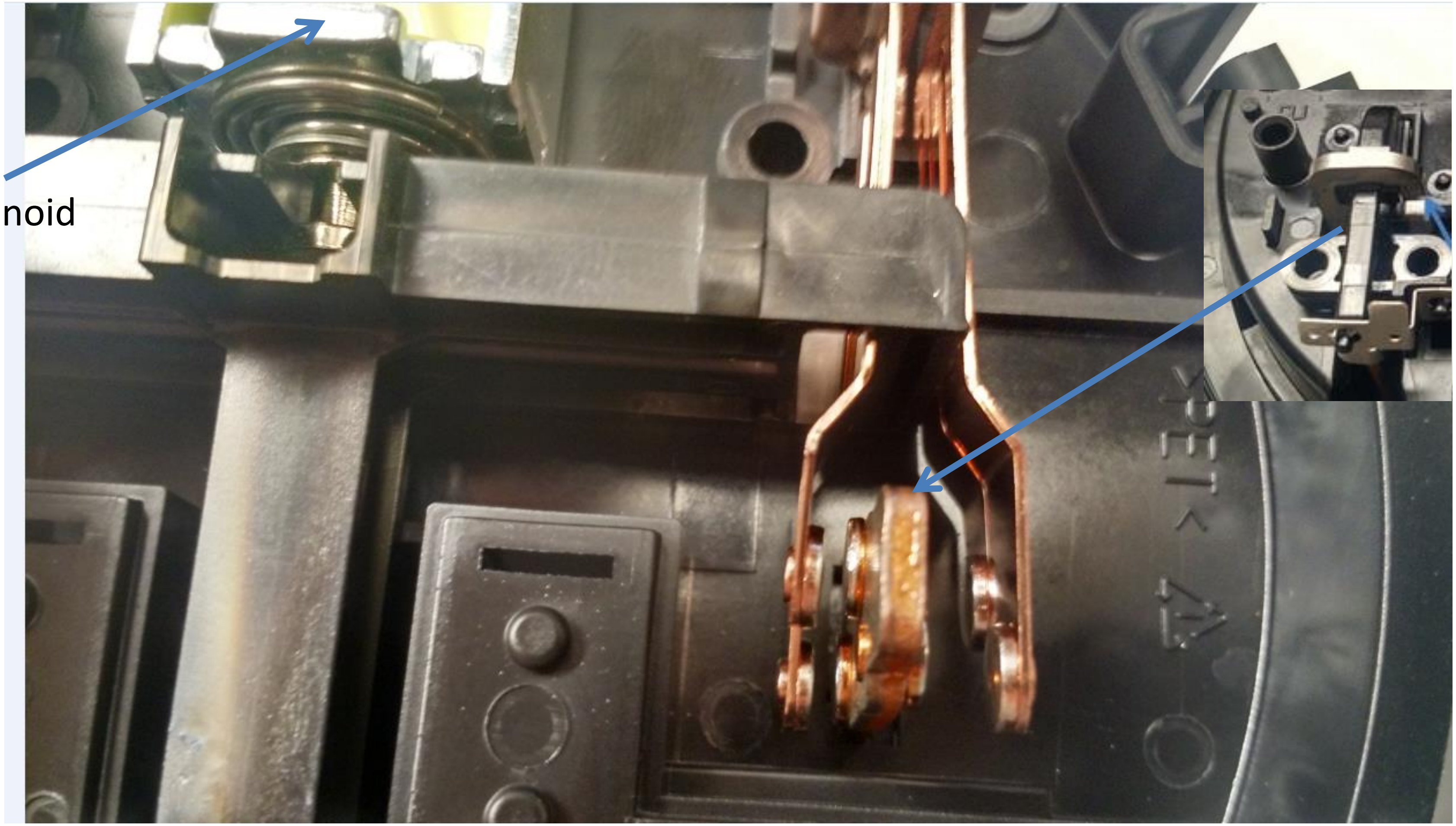
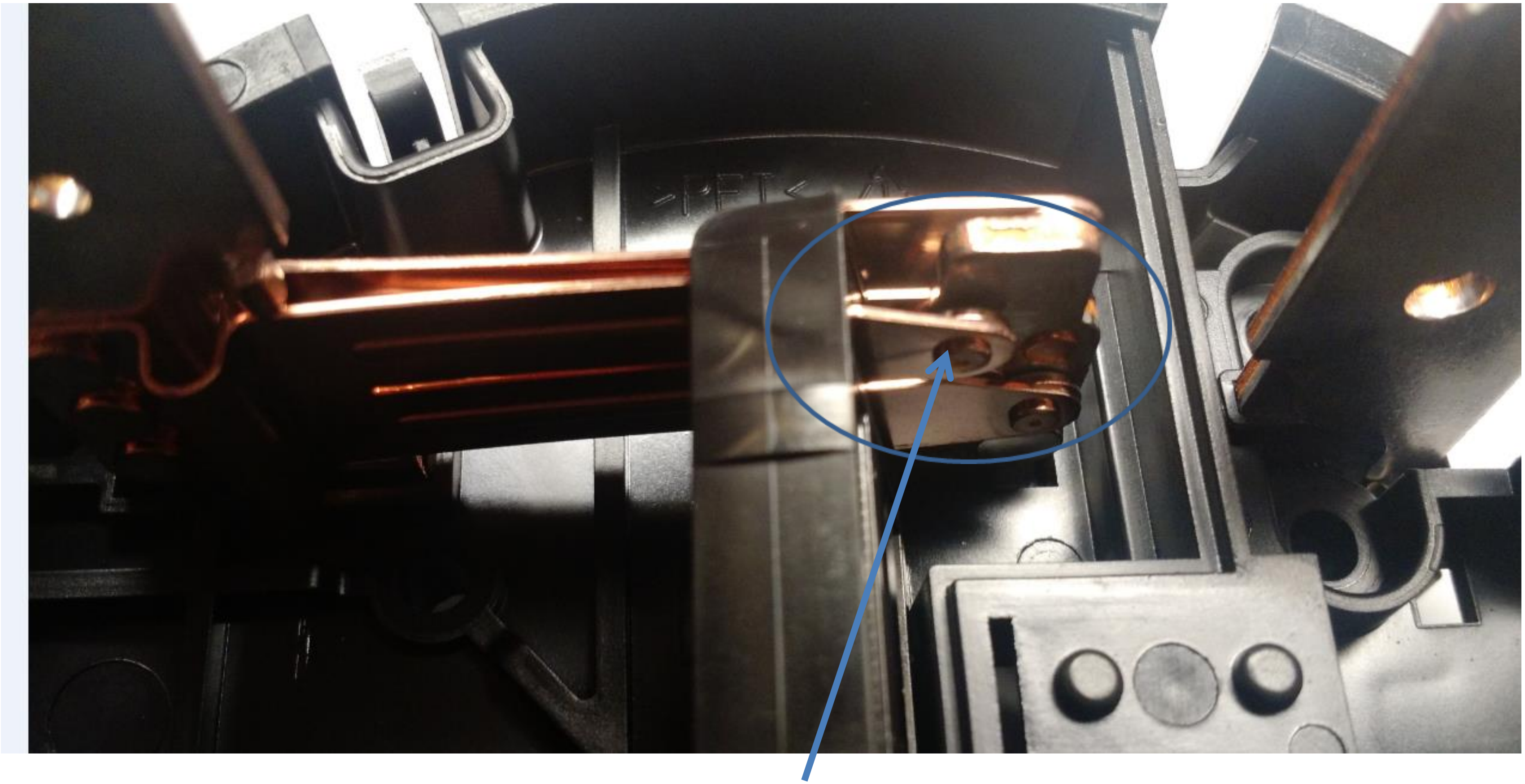
The ITRON Meter Power Disconnect



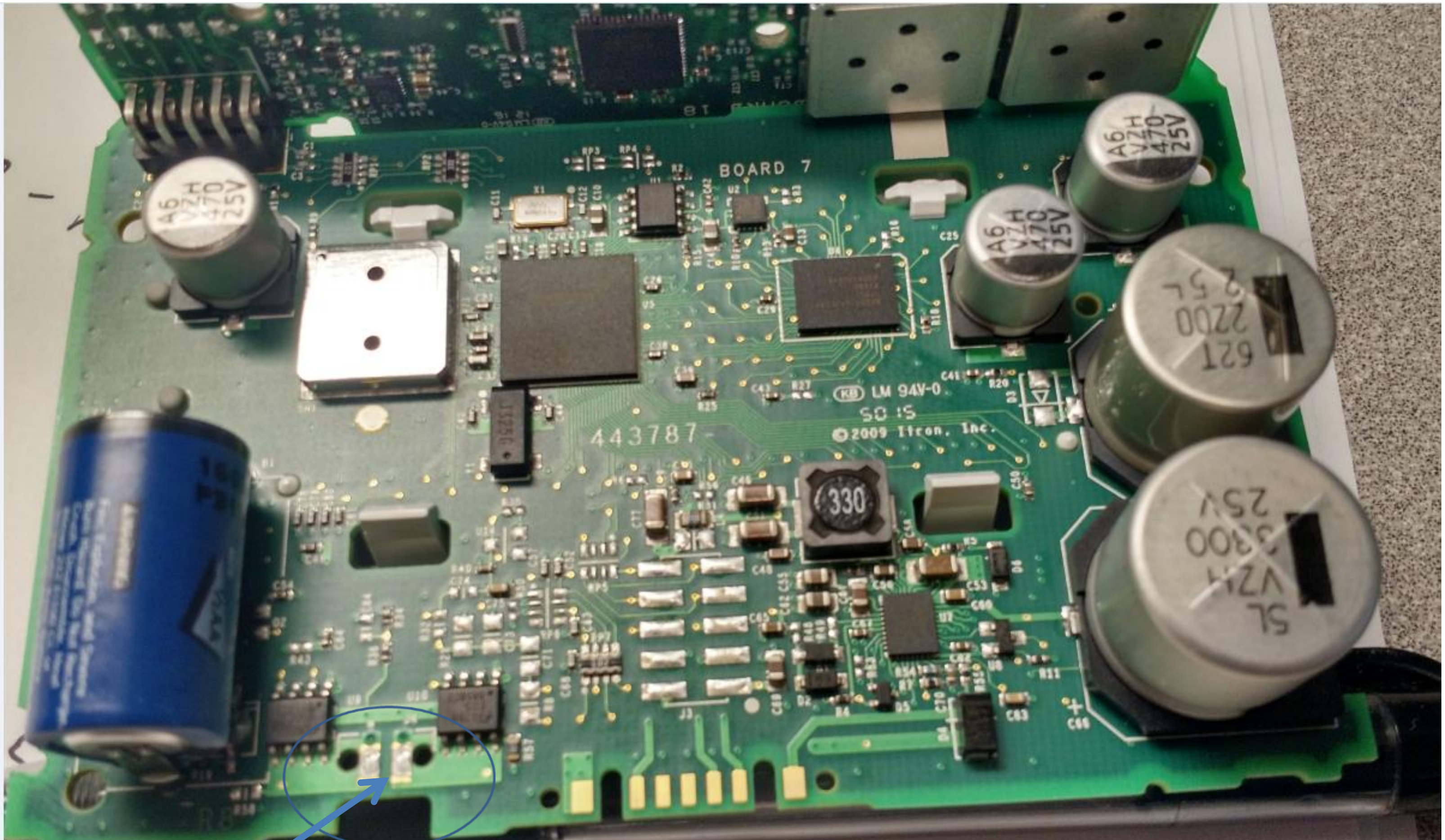
In this photo the contacts are broken from activating the solenoid against the plastic lever, there are four contacts . The vertical metal piece is aligned to the hall effect sensors on the power supply board and is encased in plastic .

The ITRON Meter Power Disconnect



In this photo the contacts are shown from the sliding the plastic lever
I will note that these contacts are relatively small and would not likely be able to withstand 200 AMPS full load. Perhaps 40 AMPs. For comparison the Landis+Gyr meters have three contacts and are 3x the size

The ITRON Meter System Board



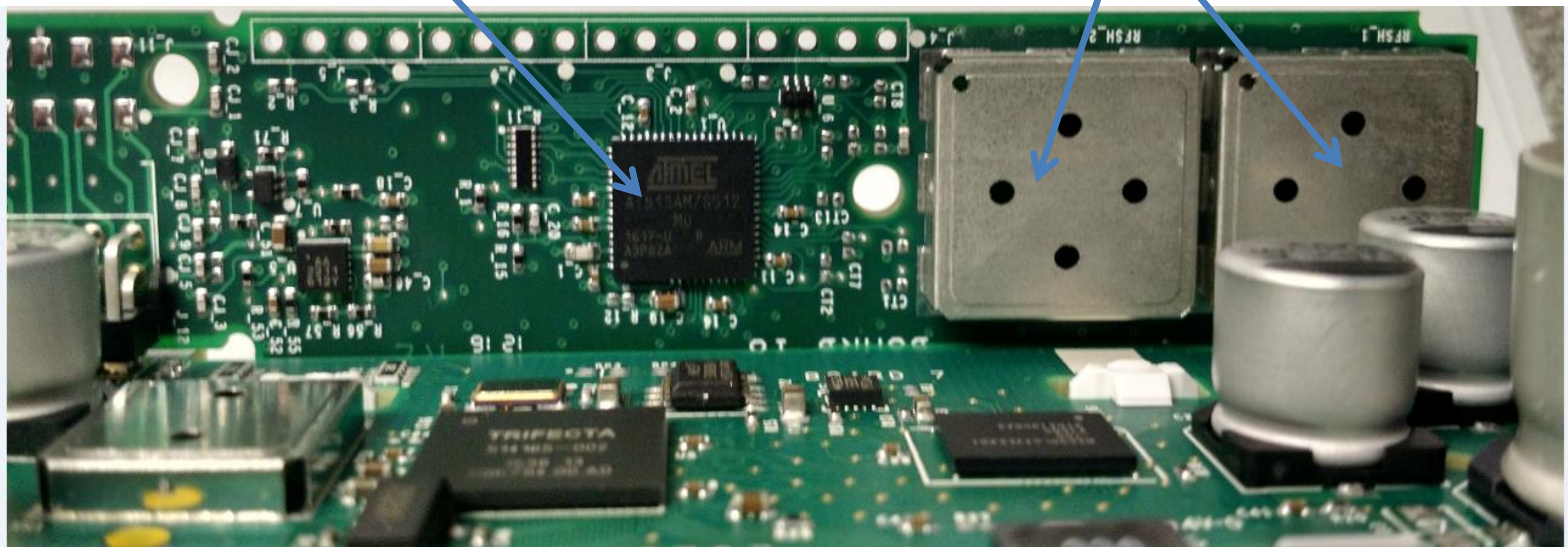
To the disconnect solenoid (24 V)

In this photo is the memory board and additional voltages for the disconnect solenoid (24 V) and is used for the LCD display (on Back of this board)

The ITRON Meter Computer and RF Transceiver Board

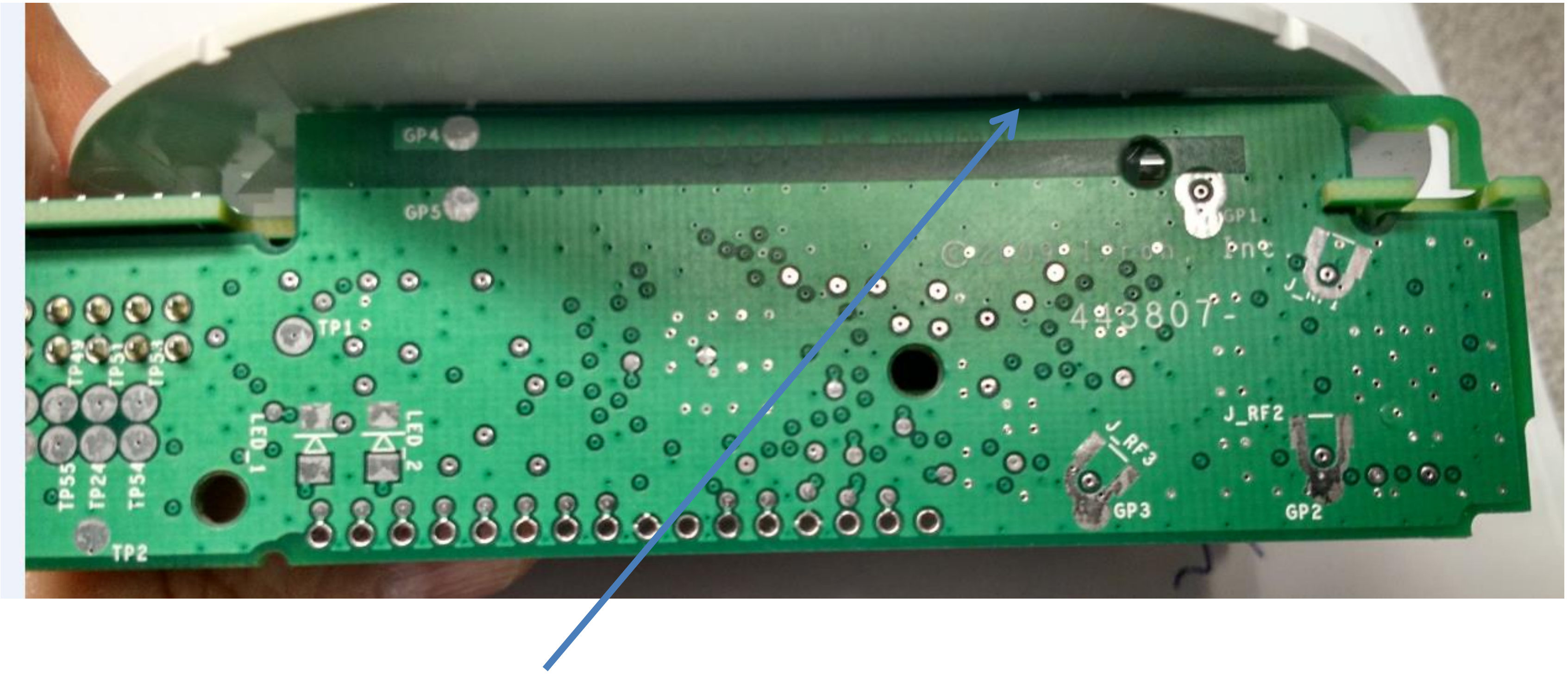
The ARM Computer Chip

The two transceivers 900 MHz and 2.4 GHz



In this photo is the computer chip (ARM Chip) board and the two transceivers

The ITRON Meter Computer and RF Transceiver Board



In this photo is the antenna for the two transceivers, they share the same circuit board trace as the antenna, the white plastic holds the LCD display.

Agenda – Part 3

Part 3 – Power Measurement and accuracy, design summary

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- **Privacy and Vulnerability to hacking**
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ITRON Radios Characteristics

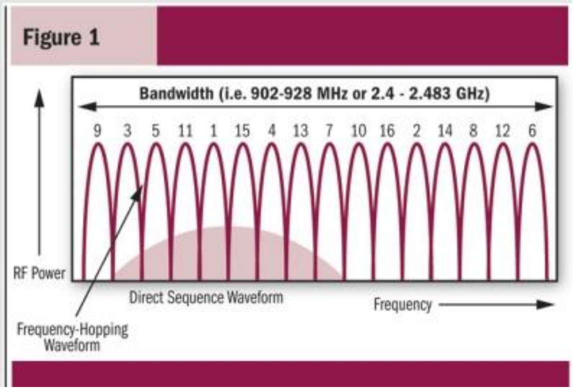
- 1st Radio Signal
  - Power rating at the meter in an **isolated** environment is within FCC specifications of less than < 1 Watt at “Unity” gain in the spec FCC Part 47.15
    - Radio transmissions are allocated by the FCC in what is called the radio spectrum. This is typically stated as the wavelength of resonance, similar to piano tuning forks which resonate as a particular sound frequency based on its length of the forks. Antennas are usually stated in the frequency of resonance and gain.
    - This meter’s 1st radio operates in the 33 CM radio spectrum which is between 902-928 MHz 33cm is called the full wavelength which about 12.99 inches long. Wavelength is important in that to fully “hear” the signal you need an antenna that is 12.99 inches in length or typically some even fraction of the full wavelength. Such as ½ or ¼ of the full wavelength. The antenna in the ITRON meter is ¼ wavelength or about 3.25 inches long.
    - It uses a “Spread Spectrum” technique and sends “packets” of information.

FCC Frequency Allocation

902-928 MHz	Spread Spectrum Transmitters	1 Watt Output Power		15.247
	Field Disturbance Sensors	500,000 µV/m @ 3 m	A	15.245
	Any	50,000 µV/m	Q	15.249
	Signals Used to Measure the Characteristics of a Material	500 µV/m @ 30 m	A	15.243
	Intermittent Control Signals	12,500 µV/m @ 3 m	A or Q	15.231
	Periodic Transmissions	5,000 µV/m @ 3 m	A or Q	15.231

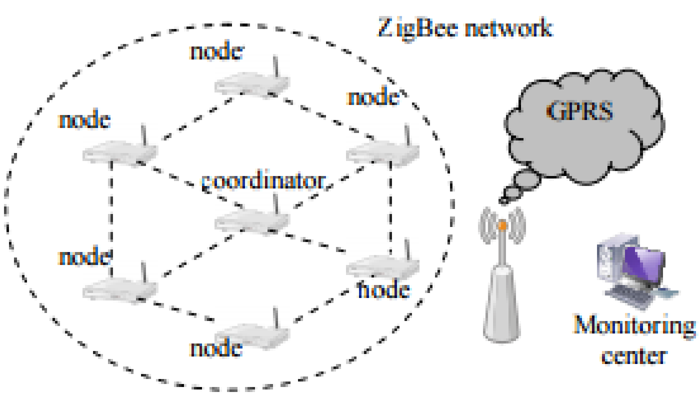
ITRON Radios Characteristics

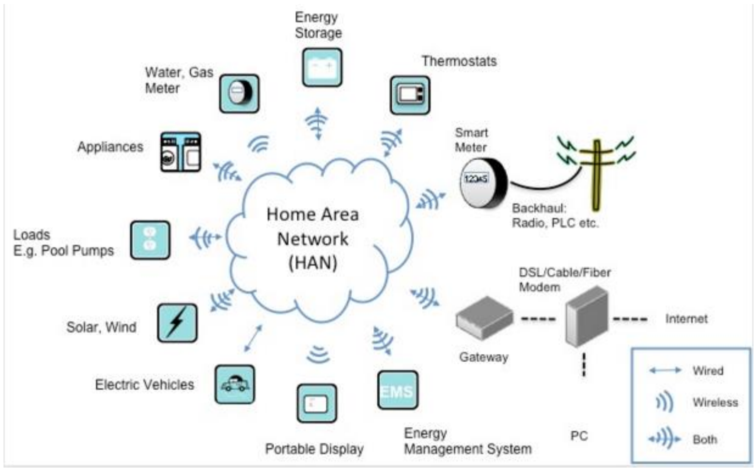
- Frequency Hopping Radio Signals
  - "Spread Spectrum" is a frequency hopping technique invented by the famous 1940's actress "Hedy Lamar" and sends "packets" of information. It was developed to foil the enemy radio signals from blocking our proximity sensing anti-aircraft shells in WWII.
    - Frequency Hopping is a technique to avoid collisions of transmitted signals, so the first packet of data will be sent to a random channel in the frequency range. If it senses that there was a collision it shifts the frequency until it is successful in sending the data packet, then the process starts all over again for the next packet. Packet size can vary from 576 bytes to 1500 bytes, ITRON does not disclose the packet size it uses. As the number of meters increase the signal experiences a lot of collisions causing retransmissions
    - The number of transmissions increases as the number of nodes in the network increases, the result is a type of radio immersion of the entire neighborhood, sometimes called a "Radio Soup" environment leaving no safe harbor from the microwave radiation.
    - Packets are sent approximately every 4-5 seconds all day based on observations of readings. The daily upload of the meter data usually occurs each night taking from one to two hours long.



ITRON Radios Characteristics

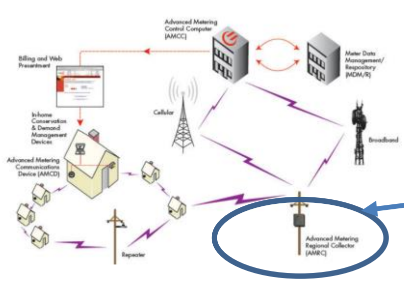
- ZIGBEE Home Area Network (HAN) Radio Signal
  - Encrypted Packet Radio Network (GPRS), @2.4GHz radio frequency
  - Uses a Mesh Network topology similar to the AMI meter's 902-928 MHz radio
  - Also uses a gateway to your home network router
  - The ITRON Meter acts as the coordinator, therefore you need to contact the utility to register each device you add to include them in the HAN network
  - The packet size is 127 bytes
  - Coordinator power levels are up to 1 Watt, though mostly 0.4 Watts



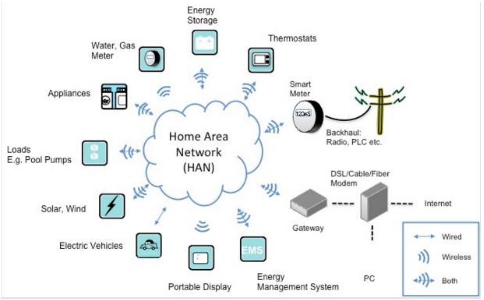


ITRON Meter Vulnerability

- Can the radio signals be hacked?
  - The 902-928 MHz and the HAN ZIGBEE 2.4 GHz radio packets are AES 128 encrypted . Therefore it is unlikely that a hacker would take the steps needed to attack your home. It would not gain them anything financially.
  - The Collector which is the most vulnerable component (Weak Link) is the regional repeater/collector. While this device cannot be easily hacked, it can be attacked. I do not condone in any way any actions but any terrorist group can obtain a shotgun and disable it by shooting it. It is unclear what individual homes would experience regarding their power, it may cause a massive power shutdown due to a "false Positive" to a tampering of the meter.
  - Another method would be to design a broadband RF interference transmitter operating at >30 Watts and flood the repeater with signals so it cannot collect data.

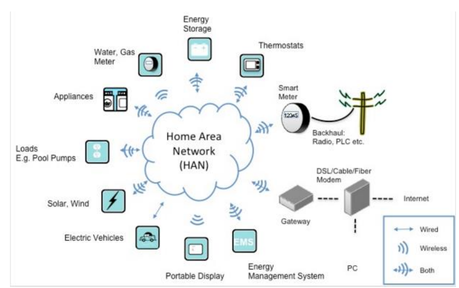


Weak Link



ITRON Meter Vulnerability

- Privacy - Can your personal information be hacked?
  - The 902-928 MHz radio sends personal usage on a 15 minute interval to the utility. The signal can determine if you are at home, when you use your power the most, and whether the load is resistive (Light Bulbs) or inductive (electric motors).
  - With the Energy Bridge device they can determine the model number and serial number of the appliances you have, turn off your appliances remotely without your permission and share your personal information with third parties you will not be able to control. They also can connect to your Smart TV and scan what TV shows you watch and report that to third parties. With a Smart TV they can actually listen to your conversations. Spam and fishing attacks will likely expand
  - With the Energy Bridge device they can connect to your home network router and listen to your internet traffic such as VOIP phone conversations, emails, streamed downloads etc. Since they will be directly connected to the router via a wired connection and do not need encryption to detect the traffic.
  - Each Meter also has a infrared LED at the top which flashes more frequently as you use more power. If you have a night vision goggle you can readily see this. Police can use this as an indicator of a possible illegal drug growing indicator. Thieves can use this to determine if a house is not occupied at the time.



Meter accuracy and your bill

- The AMI meter is “accurate” based on the Navigant Consulting Report in 2010 and referenced on the ITRON web site. However within this report the extremely high rate of billing complaints after the installation of the new meters is evident and explanations were difficult to verify as to their cause. The number of complaints was dramatic This test was done in Texas with temperature ranges from ~30 to ~88 degrees.

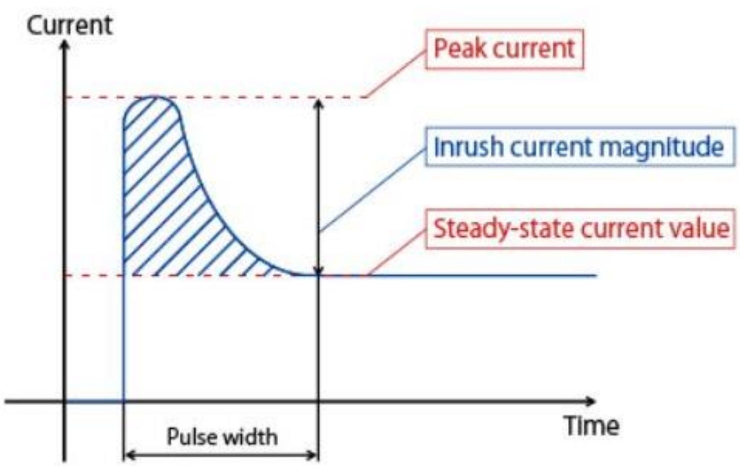
- Control testing conditions were not well explained in this report, in particular the type of load the meter accuracy was compared to.

  - Restive loads such as light bulbs
  - Inductive loads such as electric motors
  - No discussion on how the meters did the kWh calculation, with averaging of samples over a fixed period of time?

- The meter electronic sensor used to calculate power is called the “Hall Effect Sensor” in the AMI meter versus the “Eddy Current” sensor in the Analog meter. Both methods are accurate and within ANSI standards of 2%. What is very different in the AMI meter is the algorithm used to calculate the readings from the sensor into the indicated display. The analog meter is a type of “totalizing” meter just like a gas pump. The AMI meter uses sensor data, which has to be averaged by a mathematical calculation and then registered into memory and on the LCD display. The gas pump has a weight and measures standards sticker to assure the Consumer they are getting what they paid for, there is no such concept on an AMI meter.

Meter accuracy and your bill

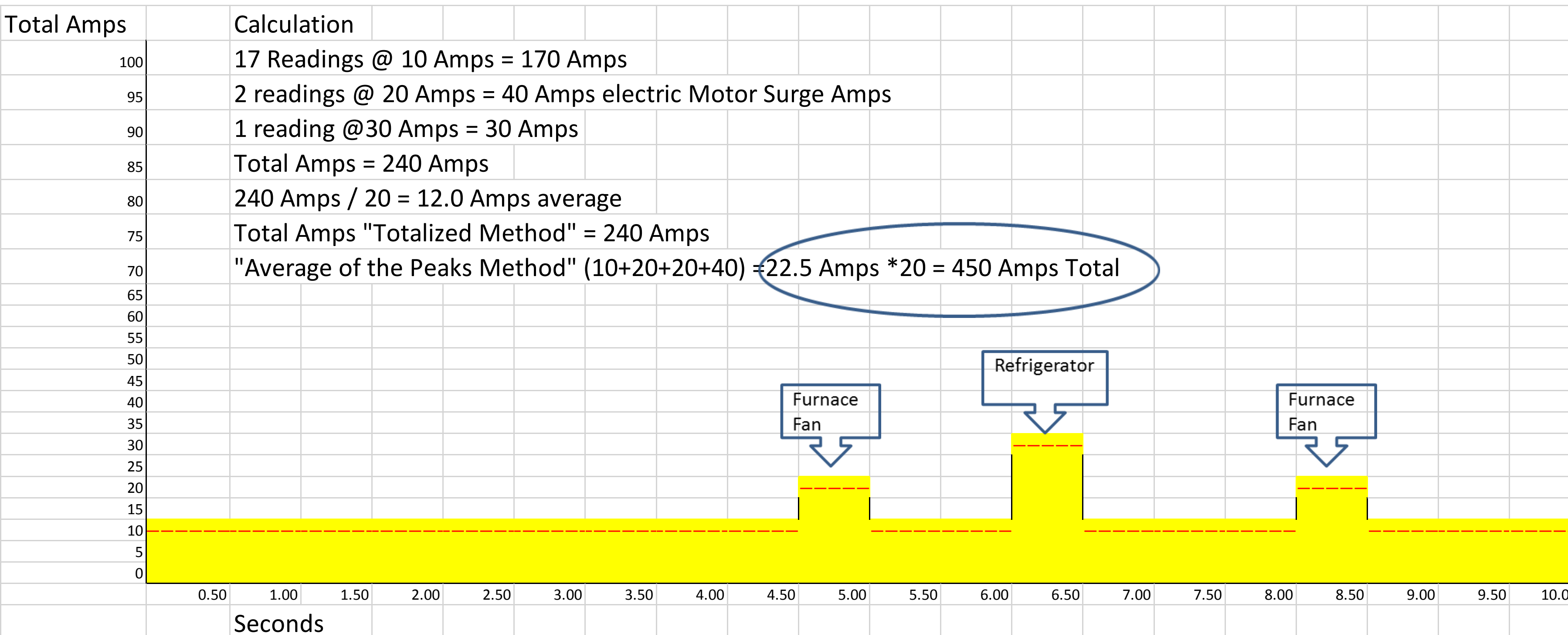
- Navigant Consulting's Report in 2010 is referenced on the ITRON web site. But there were two different meter manufacturers ITRON and Landis+Gyr. The report did not differentiate performance characteristics between manufacturers
- The Navigant Report tried to explain the billing inaccuracies using complex mathematic explanations and reference to "degree" days but the degree variance was typically within 10% year over year, yet this did not explain power bills increasing as much as 25%-40% higher year over year.
- Their test lab control set setups were done at room temperatures as shown in pictures in the report
- There was no field test at various temperatures for accuracy, nor was there a test using electric motors, they only lab tested with light bulbs, two completely different variables.



Electric Motor Current Draws are different than a light bulb

- There is a short .5 to .6 sec burst of current needed to start an electric motor, so a 5 amp rated motor may need 8-9 amps to get rotating up to rated speed
- If the utility is measuring peak current and averaging this over a window of time you can skew the average when you combine the two types of loads.
- Only the utility knows the math in the software
- If you have "Energy Star" refrigerator/freezer it starts and stops frequently, and so the skew of the average is worse, imagine the impact on the average reading after 3-5 motors start and stop in the sample window.

Why is the Bill Higher?
It depends on how it is calculated
Totalized versus Average of the Peaks



The utilities will not likely reveal how they are doing this calculation, unless forced under court order

Meter accuracy and your bill – Power Required to Run the AMI Meter

Data Source – DTE Energy Insight Phone Application
Test Conditions: Main breaker ON, All branch circuits OFF
Home Unoccupied – Skipped dates are from periods when we were moving into the home and we excluded any dates when we needed to turn on a light bulb

Date	kWh Consumed by the AMI Meter
October 17, 2016	1.8 kWh
October 18, 2016	3.0 kWh
October 19, 2016	2.2 kWh
October 20, 2016	3.2 kWh
October 21, 2016	2.1 kWh
October 25, 2106	2.4 kWh
October 26, 2016	2.2 kWh
October 27, 2016	2.1 kWh
October 28, 2016	2.3 kWh
Average Daily AMI kWh Use	2.37 kWh @ 0.13 per kWh = $0.31

Meter accuracy and your bill – Power Required to Run the AMI Meter

Based on real collected data, not extrapolated calculations

- At ~ $.31 per day cost just to run the AMI meter this equals an added $113.15 per year per customer for 865 kWhs annualy

- If you consider the total annual AMI kWh use for the 2.1 M DTE customers @ $113.15 this is an added $238,350,000 in added revenue to DTE to run the AMI meters, fully paid by the customer base

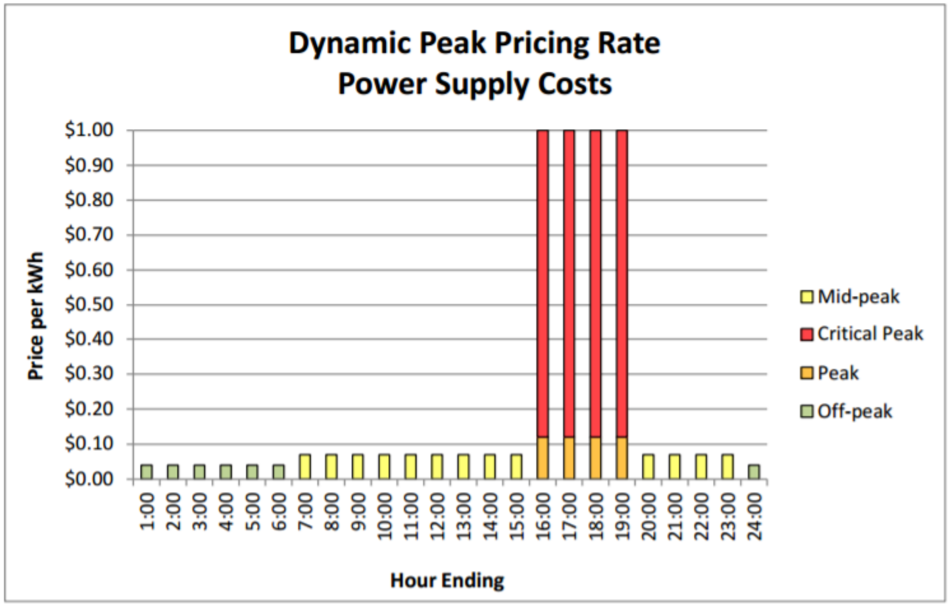
- If you also consider the Annual kWh consumed by just running the AMI meters in the 2.1 Million Customers in the DTE territory this equals an added 1,816,605,000 kWh in required added generation capacity just to run the AMI meters.

Conclusion: There is absolutely no evidence the AMI Meter program saves energy in kWh or money, in fact it only drains the bank accounts of the consumer and pads the revenue of the utility.

The only way the AMI program will save kWh's is to use it to ration power to consumers via Demand Response/Time of Use rate structures at 4-8 X normal rates where the elderly, disabled and young families with a parent and small children at home can least afford it or do without power during the Demand Response/Time of Use period. Under this scenario the AMI program is the largest fleecing of the consumer to ever exist.

What's Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy "Smart Currents" Pilot - Final Report dated August 15, 2014



1. On-Peak: All kWh used only from 3 p.m. to 7 p.m. Monday through Friday, excluding holidays, are charged at 12¢ per kWh;

2. Mid-Peak: All kWh used from 7 a.m. to 3 p.m., and from 7 p.m. to 11 p.m., Monday through Friday, excluding holidays, are charged at 7¢ per kWh;

3. Off-Peak: All kWh used from 11 p.m. to 7 a.m. Monday through Friday, and all weekend and holiday hours are charged at 4¢ per kWh; and

4. Critical-Peak: All kWh used during critical event hours, which will replace the full on-peak time period from 3 p.m. to 7 p.m. when announced in advance, are charged at $1.00 per kWh. Critical Peak events are limited to a maximum of 20 per year, or 80 hours total.

What’s Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy Current Rate Plan (excluding Distribution Charges) 2/28/2017

What's Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy Current Rate Plan versus a TOU Plan (excluding Distribution Charges) Net **a 53% Increase** in your bill

A Typical Day Excluding Distribution Charges up to Feb 22, 2017					Under DR/TOU	
Analog Meter	Time of Day	kWh Used	Costs@0.07888	AMI Meter	Variable Rate	Costs/Variable
AM	00:00 - 01:00	0.4260	$0.0336		$0.0473	$0.020
	01:00 - 02:00	0.4150	$0.0327		$0.0473	$0.020
	02:00 - 03:00	0.3870	$0.0305		$0.0473	$0.018
	03:00 - 04:00	0.4200	$0.0331		$0.0473	$0.020
	04:00 - 05:00	0.3700	$0.0292		$0.0473	$0.017
	05:00 - 06:00	0.4320	$0.0341		$0.0473	$0.020
	06:00 - 07:00	0.4170	$0.0329		$0.0473	$0.020
	07:00 - 08:00	0.4590	$0.0362		$0.0827	$0.038
	08:00 - 09:00	0.8290	$0.0654		$0.0827	$0.069
	09:00 - 10:00	1.2340	$0.0973		$0.0827	$0.102
	10:00 - 11:00	1.4970	$0.1181		$0.0827	$0.124
	11:00 - 12:00	1.7560	$0.1385		$0.0827	$0.145
PM	01:00 - 02:00	1.3120	$0.1035		$0.0827	$0.109
	02:00 - 03:00	2.2570	$0.1780		$0.0827	$0.187
	03:00 - 04:00	1.6570	$0.1307		$0.1419	$0.235
	04:00 - 05:00	1.5070	$0.1189		$0.1419	$0.214
	05:00 - 06:00	1.4110	$0.1113		$0.1419	$0.200
	06:00 - 07:00	1.9850	$0.1566		$0.1419	$0.282
	07:00 - 08:00	1.5160	$0.1196		$0.0827	$0.125
	08:00 - 09:00	1.3940	$0.1100		$0.0827	$0.115
	09:00 - 10:00	1.4710	$0.1160		$0.0827	$0.122
	10:00 - 11:00	1.1770	$0.0928		$0.0827	$0.097
	11:00 - 12:00	0.9350	$0.0738		$0.0473	$0.044
	Total	25.2640	$1.5302			$2.343
				Net Increase from TOU --------------		53.12%

What's Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy Current Rate Plan versus a TOU Plan (excluding Distribution Charges) Net **a 15% Increase** in your bill

A Typical Day Excluding Distribution Charges after Feb 23, 2017					Under DR/TOU	
Analog Meter	Time of Day	kWh Used	Costs@0.08035	AMI Meter	Variable Rate	Costs/Variable
AM	00:00 - 01:00	0.4260	$0.0342		$0.0473	$0.020
	01:00 - 02:00	0.4150	$0.0333		$0.0473	$0.020
	02:00 - 03:00	0.3870	$0.0311		$0.0473	$0.018
	03:00 - 04:00	0.4200	$0.0337		$0.0473	$0.020
	04:00 - 05:00	0.3700	$0.0297		$0.0473	$0.017
	05:00 - 06:00	0.4320	$0.0347		$0.0473	$0.020
	06:00 - 07:00	0.4170	$0.0335		$0.0473	$0.020
	07:00 - 08:00	0.4590	$0.0369		$0.0827	$0.038
	08:00 - 09:00	0.8290	$0.0666		$0.0827	$0.069
	09:00 - 10:00	1.2340	$0.0992		$0.0827	$0.102
	10:00 - 11:00	1.4970	$0.1203		$0.0827	$0.124
	11:00 - 12:00	1.7560	$0.1411		$0.0827	$0.145
PM	01:00 - 02:00	1.3120	$0.1054		$0.0827	$0.109
	02:00 - 03:00	2.2570	$0.1813		$0.0827	$0.187
	03:00 - 04:00	1.6570	$0.1331		$0.1419	$0.235
	04:00 - 05:00	1.5070	$0.1211		$0.1419	$0.214
~~* Note >17 kWh~~	05:00 - 06:00	1.4110	$0.1134	~~Costs@0.09599~~	$0.1419	$0.200
	06:00 - 07:00	1.9850	$0.1595		$0.1419	$0.282
	07:00 - 08:00	1.5160	$0.1218		$0.0827	$0.125
	08:00 - 09:00	1.3940	$0.1120		$0.0827	$0.115
	09:00 - 10:00	1.4710	$0.1182		$0.0827	$0.122
	10:00 - 11:00	1.1770	$0.0946		$0.0827	$0.097
	11:00 - 12:00	0.9350	$0.0751		$0.0473	$0.044
	Total	25.2640	$2.0300			$2.343
				Net Increase from TOU ---------------		15.42%

What's Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy Current Rate Plan versus a TOU Plan (excluding Distribution Charges) Net **a 14% Increase** in your bill

A Typical Day Excluding Distribution Charges after Feb 23, 2017					Under DR/TOU	
AMI Meter	Time of Day	kWh Used	Costs@0.08035	AMI Meter	Variable Rate	Costs/Variable
AM	00:00 - 01:00	0.4260	$0.0342		$0.0473	$0.020
	01:00 - 02:00	0.4150	$0.0333		$0.0473	$0.020
	02:00 - 03:00	0.3870	$0.0311		$0.0473	$0.018
	03:00 - 04:00	0.4200	$0.0337		$0.0473	$0.020
	04:00 - 05:00	0.3700	$0.0297		$0.0473	$0.017
	05:00 - 06:00	0.4320	$0.0347		$0.0473	$0.020
	06:00 - 07:00	0.4170	$0.0335		$0.0473	$0.020
	07:00 - 08:00	0.4590	$0.0369		$0.0827	$0.038
	08:00 - 09:00	0.8290	$0.0666		$0.0827	$0.069
	09:00 - 10:00	1.2340	$0.0992		$0.0827	$0.102
	10:00 - 11:00	1.4970	$0.1203		$0.0827	$0.124
	11:00 - 12:00	1.7560	$0.1411		$0.0827	$0.145
PM	01:00 - 02:00	1.3120	$0.1054		$0.0827	$0.109
	02:00 - 03:00	2.2570	$0.1813		$0.0827	$0.187
	03:00 - 04:00	1.6570	$0.1331		$0.1419	$0.235
	04:00 - 05:00	1.5070	$0.1211		$0.1419	$0.214
* Note >17 kWh	05:00 - 06:00	1.4110	$0.1354	Costs@0.09599	$0.1419	$0.200
	06:00 - 07:00	1.9850	$0.1905		$0.1419	$0.282
	07:00 - 08:00	1.5160	$0.1455		$0.0827	$0.125
	08:00 - 09:00	1.3940	$0.1338		$0.0827	$0.115
	09:00 - 10:00	1.4710	$0.1412		$0.0827	$0.122
	10:00 - 11:00	1.1770	$0.1130		$0.0827	$0.097
	11:00 - 12:00	0.9350	$0.0898		$0.0473	$0.044
	Total	25.2640	$2.1846			$2.343
				Net Increase from TOU ---------------		14.33%

What's Coming? Your bill – under Demand Response or called Time of Use Rates

Data Source – DTE Energy Current Rate Plan after 2/27/17 versus a TOU Plan (excluding Distribution Charges) Net **a 249% Increase** in your bill

A Typical Hot Summar Day Excluding Distribution Charges after Feb 23, 2017					Under DR/TOU		
	Time of Day	kWh Used	Costs@0.08035		Variable Rate		Costs/Variable
AM	00:00 - 01:00	0.4260	$0.0342		$0.0473		$0.020
	01:00 - 02:00	0.4150	$0.0333		$0.0473		$0.020
	02:00 - 03:00	0.3870	$0.0311		$0.0473		$0.018
	03:00 - 04:00	0.4200	$0.0337		$0.0473		$0.020
	04:00 - 05:00	0.3700	$0.0297		$0.0473		$0.017
	05:00 - 06:00	0.4320	$0.0347		$0.0473		$0.020
	06:00 - 07:00	0.4170	$0.0335		$0.0473		$0.020
	07:00 - 08:00	0.4590	$0.0369		$0.0827		$0.038
	08:00 - 09:00	0.8290	$0.0666		$0.0827		$0.069
	09:00 - 10:00	1.2340	$0.0992		$0.0827		$0.102
	10:00 - 11:00	1.4970	$0.1203		$0.0827		$0.124
	11:00 - 12:00	1.7560	$0.1411		$0.0827		$0.145
PM	01:00 - 02:00	1.3120	$0.1054		$0.0827		$0.109
	02:00 - 03:00	2.2570	$0.1813		$0.0827		$0.187
	03:00 - 04:00	1.6570	$0.1331		$0.9500		$1.574
	04:00 - 05:00	1.5070	$0.1211		$0.9500		$1.432
* Note >17 kWh of the day	05:00 - 06:00	1.4110	$0.1354	Costs@0.09599	$0.9500		$1.340
	06:00 - 07:00	1.9850	$0.1905		$0.9500		$1.886
	07:00 - 08:00	1.5160	$0.1455		$0.0827		$0.125
	08:00 - 09:00	1.3940	$0.1338		$0.0827		$0.115
	09:00 - 10:00	1.4710	$0.1412		$0.0827		$0.122
	10:00 - 11:00	1.1770	$0.1130		$0.0827		$0.097
	11:00 - 12:00	0.9350	$0.0898		$0.0473		$0.044
	Total	25.2640	$2.1846				$7.645
				Net Increase from TOU ---------------			249.92%

ITRON AMI Meter Life Expectancy

- New to the home consumer is the deployment of an electronic power meter on the exterior of the home. There is no realistic expectation that these new meters will last 20 years of more.

  - The miniaturization of electronics constantly leaps forward in reducing the size of an electronic design. This causes the industry to obsolete certain logic chips sets within one or two years from the date of the original start of manufacturing.
  - With obsolescence comes the risk that direct replacement of a meter after 2 years with the same components is unlikely or the required software compatibility will be restrained.
  - Electronic circuits do fail under the extremes of temperature and humidity. The meters are not hermetically sealed to keep out dust and moisture. There are conformal coatings on the circuit boards which indicates they had issues with moisture on the chip sets in the past, the whole board is not covered with a conformal coating but only on special areas.
  - The number of incoming power surges hitting the Varistor on the power supply board will degrade this component over time to where it no longer protects the circuit and increasingly permits power line quality issues to enter the circuit boards. This can cause an exacerbation of the “Dirty Electricity” issues already present or circuit board failures .
  - The LCD will be hard to read after exposure to temperature extremes and humidity in less than 5 years. LCD’s are very sensitive to low temperatures, and they dim considerably below 0 ° F

Overall Observations of the ITRON Meter

- After a hard look at the design and construction of this ITRON meter there are the following observations

  - The biggest weakness is in the power disconnect, it suffers from a small surface area for the disconnect contact and would be prone to excessive heating and likely result in contact pitting and carbon deposits that are not readily visible by the customer and there is not a sensory circuit that could detect it and report it to the consumer or the utility. This design would be prone to creating unpredicted fires.

  - The second weakness which is causing thousands to become ill is the lack of a common mode and differential filtering of the SMPS oscillations being injected from the meter onto the house wiring circuit, thus making the whole house into an antenna with dangerous RFI/EMI. Overall costs for the needed components would be around $1.50 per meter/circuit board. There are ways to design a SMPS without these filters but this design would need to have a solid ground reference to earth, but this meter design and construction does not permit an earth ground so this scenario is unfeasible.

  - The power required to run the AMI meter is borne by the homeowner, this was never disclosed to the public that their bill will go up by over ~$115.00 per year just to power the meter. Also the added load on generating capacity was never used in the justification for the investment required for the deployment of AMI. This gives a false impression on the AMI program reducing energy consumption. It does not save any energy for the consumer or the utility. The current Analog meter does not cost the consumer or the utility any energy to power it.

Overall Observations of the ITRON Meter

- Additional observations

  - The privacy and security of the full AMI program is another exposure that has not been fully disclosed to the consumer. The broad based scenario of incorporating the Internet of Things (IoT) in the home environment and linking it to a meter creates increased exposure of personal information to third parties without consent. The fact that the consumer agreed to the service agreement of the utility for provision of electricity also implies the the consumer has by default agreed to the disclosure of personal information to places not named should be a large concern. Image if this was the case when you buy gas for your vehicle. Should the gas provider require you to ID the type of vehicle you are driving before the pump is tuned on?

  - The utility consistently states the RF emissions of the meters meet FCC requirements, this is a misleading statement, FCC requirements are for the effects of enough ionizing power to cause the brain to heat up 1° C. There have been over 800 peer reviewed independent studies not funded by the industry that have linked this type of low level non ionizing RF radiation to a group of diseases including brain cancer, Parkinson's, Alzheimer's, high blood pressure, Tinnitus, skin rashes and open sores as an example. Industry funded studies do not concur with these findings so this adds to confusion on the health effects attributed to the meters. I have personally met many of the affected consumers and this is no joke or set of psychological conditions.

  - The fact that there is a set of circuit boards in a power meter at all is a large risk, the circuit boards would not be able to withstand a lightning strike or a power surge without an explosive reaction and likely melting of the circuits. This would lead to total destruction of the unit and lead to a possible fire.

Has the investment in new AMI meters benefited the consumer?

- The utility is passionate about the need for AMI. Their primary benefits are:
  - Reduction in meter reader workforce costs
    - The has been no rebate or discount to the consumer for this savings the utility gains, where did this savings go?
  - Ability to monitor the expanse of outages
    - This may marginally benefit the consumer but communications of their outage existed before via phone anyway. However the savings to the utility has never been remunerated and returned to consumers.
  - Ability to turn off services to non paying consumers without out a "Truck Roll"
    - This will save the utility money, yet the savings are not passed on to the consumer, every time a truck roll is avoided the utility should be sending a check equal to that costs savings to the consumer base.
  - Ability to save energy
    - The AMI meters themselves increases demand for energy capacity and costs the consumer ~115.00 per year in added costs they were never told about. In addition there is a question of fairness in reporting how inductive loads are calculated in the meter readings. The lack of transparency in the data manipulations for inductive loads versus resistive loads has never been elaborated by the utility.
    - The only way this will save energy is to require 100% compliance to Time of Use/Demand response to ration power to consumers. Demand Response policies have never been explained and enumerated to the consumer and many of these policies are already in the pipeline. Federal law requires that if DR is made available in a service area it is to be 100% enforced.
  - Ability to incorporate alternative energy sources
    - This only applies to the utility. The utilities are blocking consumers the ability to sell back to the grid. The utilities have increased their rates to build alternative energy sources and increased their billing to pay for these facilities. However they are also charging the current rates to the customer for what they now obtain for free.
  - Ability to dynamically manage energy demands
    - The use of a network topology for meter reading is a benefit to the utility to possibly obtain real time information to match capacity to demands. However the AMI system is only communicating power consumption on a daily basis so how is this to become a real time system unless the AMI meters begin transmitting demand at an almost constant rate. This has never been communicated to the consumer. The load of data collected if in a real time system would overwhelm the ability to process the data. If the intent is managing capacity to demand is the reason for deploying AMI then collecting the data once a day will not ever accomplish the goal to match capacity to demand. This is the critical flaw in the AMI concept at the point of use and the whole reasoning to deploy AMI and fails to accomplish this goal of dynamically managing the grid when only collecting data once a day. Since the AMI enabled Gas meters rely on the electric AMI meter, and the AMI electric meter justification is dubious with only daily readings the sum of the benefits of AMI is only related to elimination of manual meter readers, which has not resulted in any consumer savings.
  - The need for AMI to reduce energy consumption
    - The most recent report from Michigan LARA estimate from 2014-2015 year predicts residential electric energy consumption as flat, with commercial consumptions reducing and industrial sectors growing by 3 % with a combined increase of 0.8 %. The revised report for 2016-2017 still states the growth as lower than historic values. Why do we need hundreds of millions of added costs to support a flat demand curve? Is this a solution looking for a problem?