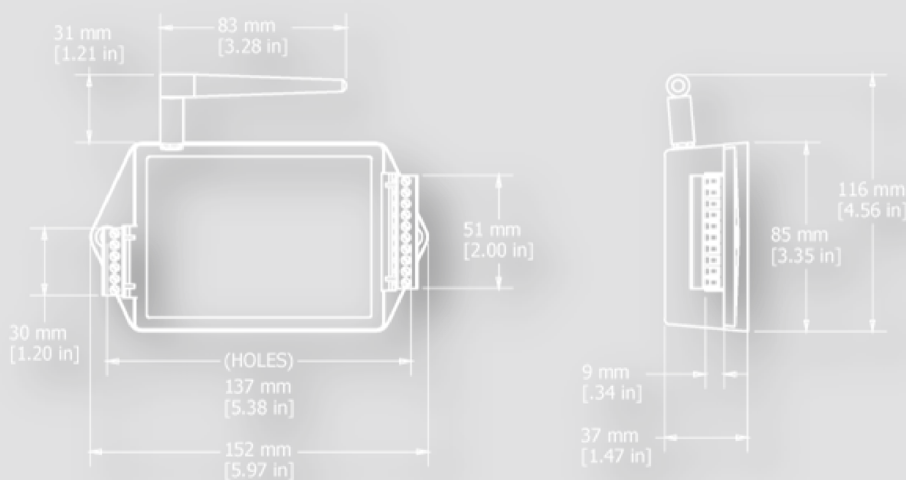
LORD MANUAL

Watt-Link™

Register List



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Chapter 1 - Precautions

Buyer Acknowledgement

BUYER ACKNOWLEDGES AND AGREES THAT THE WATT-LINK PRODUCTS (THE "PRODUCTS") MUST BE INSTALLED ONLY BY A LICENSED ELECTRICIAN AUTHORIZED TO CONDUCT BUSINESS IN THE JURISDICTION IN WHICH THE PRODUCTS ARE TO BE INSTALLED. IN ADDITION, BUYER AGREES THAT SELLER SHALL HAVE NO LIABILITY WHATSOEVER FOR ANY DAMAGES RESULTING FROM THE INSTALLATION OF A PRODUCT BY ANY PERSON THAT IS NOT A LICENSED ELECTRICIAN IN THE JURISDICTION IN WHICH THE PRODUCT IS INSTALLED. FURTHERMORE, REGARDLESS OF WHETHER THE PERSON THAT IS INSTALLING A PRODUCT IS A LICENSED ELECTRICIAN, BUYER AGREES THAT SELLER SHALL NO LIABILITY WHATSOEVER IN CONNECTION WITH ANY DAMAGES RESULTING (i) DURING THE INSTALLATION OF THE PRODUCT AND/OR (ii) FROM THE IMPROPER INSTALLATION OF THE PRODUCT.

Precautions

These installation/servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

Always adhere to the following checklist:

1. Only a licensed electrician qualified to conduct business in the jurisdiction where the products are to be installed may install the Watt-Link™ meter. **The mains voltages of 120 Vac to 600 Vac can be lethal!**
2. Follow all applicable local and national electrical and safety codes.
3. Install the meter in an electrical enclosure (panel or junction box) or in a limited access electrical room.
4. Verify that circuit voltages and currents are within the proper range for the meter model.
5. Use only UL recognized current transformers (CTs) with built-in burden resistors, that generate 0.333 Vac (333 millivolts AC) at rated current. Do not use current output (ratio) CTs such as 1 amp or 5 amp output CTs: they will destroy the meter and may create a shock hazard..
6. Ensure that the line voltage inputs to the meter are protected by fuses or circuit breakers (not needed for the neutral wire).
7. Equipment must be disconnected from the **HAZARDOUS LIVE** voltages before access.
8. The terminal block screws are not insulated. Do not contact metal tools to the screw terminals if the circuit is live!
9. Do not place more than one line voltage wire in a screw terminal; use wire nuts instead. You may use more than one CT wire per screw terminal.
10. Before applying power, check that all the wires are securely installed by tugging on each wire.
11. Do not install the meter where it may be exposed to temperatures below –30°C or above 55°C, excessive moisture, dust, salt spray, or other contamination. The meter requires an environment no worse than pollution degree 2 (normally only non-conductive pollution; occasionally, a temporary conductivity caused by condensation must be expected).
12. Do not drill mounting holes using the meter as a guide; the drill chuck can damage the screw terminals and metal shavings can fall into the connectors, causing an arc risk.
13. If the meter is installed incorrectly, the safety protections may be impaired.
14. Read and fully understand this quick start guide and the installation guide in entirety before attempting to install or operate the Watt-Link™.

Table 1. Symbol Definitions

Symbol	Definition
	Read, understand, and follow all instructions including warnings and precautions before installing and using the product.
	Potential shock hazard from dangerous high voltage.
	Functional ground; should be connected to earth ground if possible, but is not required for safety grounding.
	UL Listing mark.
	FCC Mark. This logo indicates compliance with part 15 of the FCC rules
	Complies with the regulations of the European Union for Product Safety and Electro-Magnetic Compatibility.
	This indicates an AC voltage.

Chapter 2 - Register Lists

This section lists the available registers. The following sections provide detailed information about each register. The registers are grouped as follows:

- **Basic Registers:** Floating Point
- **Basic Registers:** Integer
- **Advanced Registers:** Floating Point
- **Advanced Registers:** Integer
- **Configuration Registers:** Integer
- **Customer Diagnostic Registers:** Integer

Floating Point and Integer Registers

Most registers are available in floating point and integer formats. We generally recommend using the floating point registers, because they provide more resolution and dynamic range and they never requiring scaling. However, for energy variables, the 32 bit integer registers may be a better choice, because they provide a constant resolution of 0.1 kWh.

Most of the integer registers are 16 bit signed integers that can report positive or negative values from -32,768 to +32,767. In a few special cases, such as the energy registers, we use 32 bit signed integer registers (sometimes called "long integer"), which use two adjacent registers and can report values up to approximately ± two billion.

Floating point values can report positive or negative values with typically six or seven significant digits, which is far higher than the Watt-Link™ meter's accuracy. However, for energy measurements (kWh), floating point values have a limitation: the effective resolution in kWh gets lower as more energy accumulates. If the total energy exceeds 100,000 kWh, the resolution of the floating point energy will become coarser than 0.1 kWh, the constant resolution of the integer energy values. At a total energy of 1,000,000 kWh, the floating point energy resolution becomes 1.0 kWh.

Reading and Writing Registers

To read and write registers go, to the Read/Write Modbus Register Menu as outlined in the Software Operating Instructions.

Reading 16-bit Integers

Figure 1 illustrates the following procedure to read a 16-bit register.

1. Select 16-bit integer as the data type.
2. Select "Read Holding Registers" in the Read Options menu.
3. Select 1 as the Slave Address.
4. Type in the register address you wish to read. In this example, we're using the Phase A CT current rating (1603).
5. Press the read button. Figure 1 shows that the CT rating was set to 5.

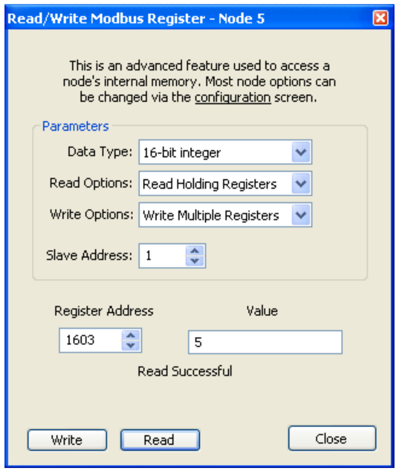

Figure 1. Read 16-bit Integer

Writing 16-bit Integers

6. Say we want to change the CT rating to 20 amps. Select "Write Single Register" as the write option.
7. Type 20 into the Value box and press write. See Figure 2 for reference.

Figure 2. Write 16-bit Integer

8. You can verify the read by pressing the Read button.

Reading 32-bit Integers

The procedure to read a 32-bit integer is similar to reading a 16-bit integer. There are two differences:

1. The user needs to select 32-bit integer as the data-type.
2. The user has two registers listed but only needs to type in the first register address. The software will read the second register automatically.

In this example, we're reading the UptimeSecs register (1703, 1704). The user only needs to type in 1703 and then press the Read button. Figure 3 illustrates this process.

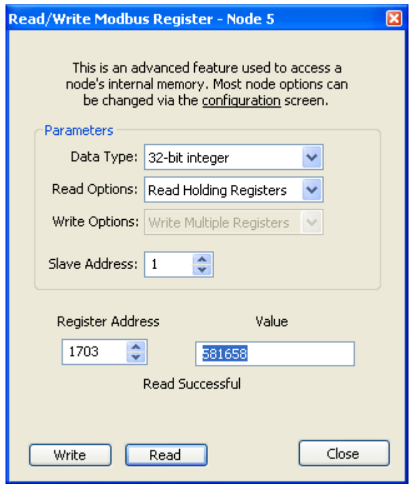

Figure 3. Reading a 32-bit Register

Reading 32-bit Floating Point

The procedure to read a 32-bit Floating Point is similar to reading a 32-bit integer. The only difference is that the user needs to select "32-bit float" as the data-type. The user has two registers listed but only needs to type in the first register address. The software will read the second register automatically.

In this example, we're reading the Voltage, Phase A (1019, 1020). The user only needs to type in 1019 and then press the Read button. Figure 4 illustrates this process. The voltage is 123.006 VAC.

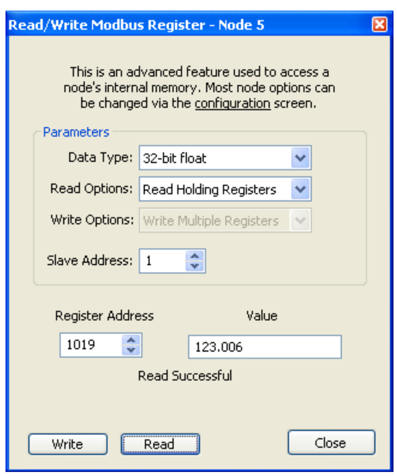

Figure 4. Reading 32-bit Floating Point

Writing 32-bit Integers and 32-bit Floating Point

Watt-Link™ does not support writing 32 bit integers and 32-bit Floating Point values.

Basic Register List - Floating Point

The following registers provide the most commonly used measurements in floating point units. See *Basic Registers* below for detailed information.

Table 2. Basic Floating Point Energy Registers

Registers	Name	Units	Description
1001, 1002	Energy Sum*	kWh	Total net (bidirectional) energy
1003, 1004	Energy Positive Sum*†	kWh	Total positive energy
1005, 1006	Total Net Energy NR*	kWh	Total net energy. Not resettable
1007, 1008	Total Positive Energy NR*	kWh	Total positive energy. Not resettable

Table 3. Basic Floating Point Power Registers

Registers	Name	Units	Description
1009, 1010	Power Sum	W	Real power, sum of active phases.
1011, 1012	Power, Phase A	W	Real power, phase A
1013, 1014	Power, Phase B	W	Real power, phase B
1015, 1016	Power, Phase C	W	Real power, phase C

Table 4. Basic Floating Point Voltage and Frequency Registers

Registers	Name	Units	Description
1017, 1018	Average Line to Neutral Voltage	V	Average line-to-neutral voltage
1019, 1020	Voltage, Phase A	V	RMS voltage, phase A to neutral.
1021, 1022	Voltage, Phase B	V	RMS voltage, phase B to neutral.
1023, 1024	Voltage, Phase C	V	RMS voltage, phase C to neutral.
1025, 1026	Average Line to Line Voltage	V	Average line-to-line voltage
1027, 1028	Voltage, Phase A to B	V	RMS voltage, phase A to phase B.
1029, 1030	Voltage, Phase B to C	V	RMS voltage, phase B to phase C.
1031, 1032	Voltage, Phase A to C	V	RMS voltage, phase A to phase C.
1033, 1034	Frequency	Hz	Power line frequency

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Basic Register List - Integer

The following registers provide the most commonly used measurements in integer units. The energy registers are 32 bit signed integer values. See *Basic Registers* below for detailed information.

Table 5. Basic Integer Energy Registers

Registers	Name	Units	Description
1201, 1202	Energy Sum*	0.1 kWh	Total net (bidirectional) energy
1203, 1204	Energy Positive Sum*†	0.1 kWh	Total positive energy
1205, 1206	Total Net Energy NR*	0.1 kWh	Total net energy. Not resettable
1207, 1208	Total Positive Energy NR*	0.1 kWh	Total positive energy. Not resettable

Table 6. Basic Integer Power Registers

Registers	Name	Units	Description
1209	Power Sum	PowerIntScale	Real power, sum of active phases.
1210	Power, Phase A	PowerIntScale	Real power, phase A
1211	Power, Phase B	PowerIntScale	Real power, phase B
1212	Power, Phase C	PowerIntScale	Real power, phase C

Table 7. Basic Integer Voltage and Frequency Registers

Registers	Name	Units	Description
1213	Average Line to Neutral Voltage	0.1 V	Average line-to-neutral voltage
1214	Voltage, Phase A	0.1 V	RMS voltage, phase A to neutral.
1215	Voltage, Phase B	0.1 V	RMS voltage, phase B to neutral.
1216	Voltage, Phase C	0.1 V	RMS voltage, phase C to neutral.
1217	Average Line to Line Voltage	0.1 V	Average line-to-line voltage
1218	Voltage, Phase A to B	0.1 V	RMS voltage, phase A to phase B.
1219	Voltage, Phase B to C	0.1 V	RMS voltage, phase B to phase C.
1220	Voltage, Phase A to C	0.1 V	RMS voltage, phase A to phase C.
1221	Frequency	0.1 Hz	Power line frequency

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Advanced Register List - Floating Point

The following registers provide more advanced measurements in floating point units. See *Advanced Registers* below for detailed information.

Table 8. Floating Point Energy Registers

Registers	Name	Units	Description
1101, 1102	Energy, Phase A*†	kWh	Net (bidirectional) energy, phase A
1103, 1104	Energy, Phase B*†	kWh	Net (bidirectional) energy, phase B
1105, 1106	Energy, Phase C*†	kWh	Net (bidirectional) energy, phase C
1107, 1108	Positive Energy, Phase A*†	kWh	Positive energy, phase A
1109, 1110	Positive Energy, Phase B*†	kWh	Positive energy, phase B
1111, 1112	Positive Energy, Phase C*†	kWh	Positive energy, phase C
1113, 1114	Negative Energy, Sum of Active Phases*†	kWh	Negative energy, sum of active phases
1115, 1116	Negative Energy, Sum of Active Phases NR*	kWh	Negative energy, sum of active phases (not resettable)
1117, 1118	Negative Energy, Phase A*†	kWh	Negative energy, phase A
1119, 1120	Negative Energy, Phase B*†	kWh	Negative energy, phase B
1121, 1122	Negative Energy, Phase C*†	kWh	Negative energy, phase C
1123, 1124	Reactive Energy, Sum of Active Phases*†	kVARh	Reactive energy, sum of active phases
1125, 1126	Net Reactive Energy, Phase A*†	kVARh	Reactive energy, phase A
1127, 1128	Net Reactive Energy, Phase B*†	kVARh	Reactive energy, phase B
1129, 1130	Net Reactive Energy, Phase C*†	kVARh	Reactive energy, phase C
1131, 1132	Apparent Energy, Sum of Active Phases*†	kVAh	Apparent energy, sum of active phases
1133, 1134	Apparent Energy, Phase A*†	kVAh	Apparent energy, phase A
1135, 1136	Apparent Energy, Phase B*†	kVAh	Apparent energy, phase B
1137, 1138	Apparent Energy, Phase C*†	kVAh	Apparent energy, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Table 9. Floating Point Power and Power Factor Current Registers

Registers	Name	Units	Description
1139, 1140	Average Power Factor		Power factor, average
1141, 1142	Power Factor, Phase A		Power factor, phase A
1143, 1144	Power Factor, Phase B		Power factor, phase B
1145, 1146	Power Factor, Phase C		Power factor, phase C
1147, 1148	Reactive Power Sum	VAR	Reactive power, sum of active phases
1149, 1150	Reactive Power, Phase A	VAR	Reactive power, phase A
1151, 1152	Reactive Power, Phase B	VAR	Reactive power, phase B
1153, 1154	Reactive Power, Phase C	VAR	Reactive power, phase C
1155, 1156	Apparent Power Sum	VA	Apparent power, sum of active phases
1157, 1158	Apparent Power, Phase A	VA	Apparent power, phase A
1159, 1160	Apparent Power, Phase B	VA	Apparent power, phase B
1161, 1162	Apparent Power, Phase C	VA	Apparent power, phase C

Table 10. Floating Point Current Registers

Registers	Name	Units	Description
1163, 1164	Current, Phase A	A	RMS current, phase A
1165, 1166	Current, Phase B	A	RMS current, phase B
1167, 1168	Current, Phase C	A	RMS current, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Table 11. Floating Point Demand Registers

Registers	Name	Units	Description
1169, 1170	Real Power Demand Average	W	Real power demand averaged over the demand period
1171, 1172	Min Demand*	W	Minimum power demand
1173, 1174	Max Demand*	W	Maximum power demand
1175, 1176	Apparent Power Demand	W	Apparent power demand
1177, 1178	Demand, Phase A	W	Real power demand, phase A
1179, 1180	Demand, Phase B	W	Real power demand, phase B
1181, 1182	Demand, Phase C	W	Real power demand, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Advanced Register List - Integer

These registers provide advanced integer measurements. The energy registers are 32 bit signed dual registers: the first register provides the lower 16 bits, and the second register provides the upper 16 bits of the 32 bit value. See *Advanced Registers* below for detailed information.

Table 12. Integer Energy Registers

Registers	Name	Units	Description
1301, 1302	Energy, Phase A*†	0.1 kWh	Net (bidirectional) energy, phase A
1303, 1304	Energy, Phase B*†	0.1 kWh	Net (bidirectional) energy, phase B
1305, 1306	Energy, Phase C*†	0.1 kWh	Net (bidirectional) energy, phase C
1307, 1308	Positive Energy, Phase A*†	0.1 kWh	Positive energy, phase A
1309, 1310	Positive Energy, Phase B*†	0.1 kWh	Positive energy, phase B
1311, 1312	Positive Energy, Phase C*†	0.1 kWh	Positive energy, phase C
1313, 1314	Negative Energy, Sum of Active Phases*†	0.1 kWh	Negative energy, sum of active phases
1315, 1316	Negative Energy, Sum of Active Phases NR*	0.1 kWh	Negative energy, sum of active phases (not resettable)
1317, 1318	Negative Energy, Phase A*†	0.1 kWh	Negative energy, phase A
1319, 1320	Negative Energy, Phase B*†	0.1 kWh	Negative energy, phase B
1321, 1322	Negative Energy, Phase C*†	0.1 kWh	Negative energy, phase C

1323, 1324	Reactive Energy, Sum of Active Phases*†	0.1 kVARh	Reactive energy, sum of active phases
1325, 1326	Net Reactive Energy, Phase A*†	0.1 kVARh	Reactive energy, phase A
1327, 1328	Net Reactive Energy, Phase B*†	0.1 kVARh	Reactive energy, phase B
1329, 1330	Net Reactive Energy, Phase C*†	0.1 kVARh	Reactive energy, phase C
1331, 1332	Apparent Energy, Sum of Active Phases*†	0.1 kVAh	Apparent energy, sum of active phases
1333, 1334	Apparent Energy, Phase A*†	0.1 kVAh	Apparent energy, phase A
1335, 1336	Apparent Energy, Phase B*†	0.1 kVAh	Apparent energy, phase B
1337, 1338	Apparent Energy, Phase C*†	0.1 kVAh	Apparent energy, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Table 13. Integer Power and Power Factor Registers

Registers	Name	Units	Description
1339	Average Power Factor	0.01	Power factor, average
1340	Power Factor, Phase A	0.01	Power factor, phase A
1341	Power Factor, Phase B	0.01	Power factor, phase B
1342	Power Factor, Phase C	0.01	Power factor, phase C
1343	Reactive Power Sum	VAR	Reactive power, sum of active phases
1344	Reactive Power, Phase A	PowerIntScale	Reactive power, phase A
1345	Reactive Power, Phase B	PowerIntScale	Reactive power, phase B
1346	Reactive Power, Phase C	PowerIntScale	Reactive power, phase C
1347	Apparent Power Sum	PowerIntScale	Apparent power, sum of active phases
1348	Apparent Power, Phase A	PowerIntScale	Apparent power, phase A
1349	Apparent Power, Phase B	PowerIntScale	Apparent power, phase B
1350	Apparent Power, Phase C	PowerIntScale	Apparent power, phase C

Table 14. Integer Current Registers

Registers	Name	Units	Description
1351	Current, Phase A	CurrentIntScale	RMS current, phase A
1352	Current, Phase B	CurrentIntScale	RMS current, phase B
1353	Current, Phase C	CurrentIntScale	RMS current, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Table 15. Integer Demand Registers

Registers	Name	Units	Description
1354	Real Power Demand Average	PowerIntScale	Real power demand averaged over the demand period
1355	Min Demand*	PowerIntScale	Minimum power demand
1356	Max Demand*	PowerIntScale	Maximum power demand
1357	Apparent Power Demand	PowerIntScale	Apparent power demand
1358	Demand, Phase A	PowerIntScale	Real power demand, phase A
1359	Demand, Phase B	PowerIntScale	Real power demand, phase B
1360	Demand, Phase C	PowerIntScale	Real power demand, phase C

* These registers are preserved across power failures.
† These registers support resetting or presetting the value.

Configuration Register List

These integer registers configure and customize the Watt-Link™ meter. For simple installations, only **CtAmps** needs to be set. The configuration registers are all integer format. See the section *Configuration Registers* below for detailed information.

Table 16. Configuration Register List

Registers	Name	Units	Default	Description
1603	CtAmps*	1 A	5	Assign global CT rated current.
1604	CtAmpsA*	1 A	5	Phase A CT rate current (0 to 6000)
1605	CtAmpsB*	1 A	5	Phase B CT rate current (0 to 6000)
1606	CtAmpsC*	1 A	5	Phase C CT rate current (0 to 6000)
1607	CtDirections*		0	Optionally invert CT orientations (0 to 7).
1608	Averaging*		1 (fast)	Configure measurement averaging (0 to 3)
1609	PowerIntScale*	1 W	0 (auto)	Scaling for integer power registers (0 to 1000)
1610	DemPerMins*	1 Minute	15	Demand period (1 to 720)
1611	DemSubInts*		1	Number of demand subintervals (1 to 10)
1612	GainAdjustA*	1/10000th	10000	Phase A power / energy adjustment (5000 to 20000)
1613	GainAdjustB*	1/10000th	10000	Phase B power / energy adjustment (5000 to 20000)
1614	GainAdjustC*	1/10000th	10000	Phase C power / energy adjustment (5000 to 20000)
1615	PhaseAdjustA*	0.001 deg	-1000	Phase A CT phase angle adjust (-8000 to 8000)
1616	PhaseAdjustB*	0.001 deg	-1000	Phase B CT phase angle adjust (-8000 to 8000)
1617	PhaseAdjustC*	0.001 deg	-1000	Phase C CT phase angle adjust (-8000 to 8000)
1618	CreepLimit*		1500	Minimum power for readings (100 to 10000)
1619	PhaseOffset*	1 degree	120	Nominal angle between primary voltage phases (0, 60, 90, 120, or 180)
1620	ZeroEnergy		0	Write 1 to zero all resettable energy registers.
1621	ZeroDemand		0	Write 1 to zero all demand values.
1622	CurrentIntScale*		20000	Scale factor for integer currents (0 to 32767)

* These registers are preserved across power failures.

Diagnostic Register List

These registers provide information and diagnostics for the meter. These are all integer registers. **UptimeSecs** and **TotalSecs** are 32 bit integer dual registers.

Table 17. Diagnostic Register List

Registers	Name	Units	Description
1703, 1704	UptimeSecs	Seconds	Time in seconds since last power on.
1705, 1706	TotalSecs*	Seconds	Total seconds of operation
1707	Model*		Encoded Watt-Link™ Model
1710	ErrorStatus*	n.a.	List of recent errors and events.
1711	PowerFailCount*		Power failure count.
1712	CrcErrorCount		Count of Modbus CRC communication errors.
1713	FrameErrorCount		Count of Modbus framing errors.
1714	PakcetErrorCount		Count of bad Modbus packets.
1715	OverrunCount		Count of Modbus buffer overruns
1716	ErrorStatus1	n.a.	Newest error or event (0 = no errors)
1717	ErrorStatus2	n.a.	Next oldest error or event.
1718	ErrorStatus3	n.a.	Next oldest error or event.
1719	ErrorStatus4	n.a.	Next oldest error or event.
1720	ErrorStatus5	n.a.	Next oldest error or event.
1721	ErrorStatus6	n.a.	Next oldest error or event.
1722	ErrorStatus7	n.a.	Next oldest error or event.
1723	ErrorStatus8	n.a.	Next oldest error or event.

* These registers are preserved across power failures.

Chapter 3 – Register Descriptions

Basic Registers

Energy Registers

Commonly known as kWh (kilowatt-hours), the energy is the integral of power over time. Many installations will only use the energy measurement. It is commonly used for billing or sub-metering. Because energy is an accumulated value, it can be used on networks that are accessed infrequently (like a utility meter that only needs to be read once a month). All energy register values are preserved through power failures.

In the Watt-Link™ Modbus meter, most energy registers can be reset to zero by writing "1" to the **ZeroEnergy** register. They can also be set to zero or a preset value by writing the desired value directly to each register. All energy registers ending with "NR" (for non-resetting) cannot be reset to zero for billing security.

All energy registers wrap around to zero when they reach 100 gigawatt-hours (100 x 109 watthours) or negative 100 gigawatt-hours (only some energy registers allow negative values).

During a power outage, the energy consumed will not be measured. Whenever the line voltage drops below 60–80% of nominal, the meter will shut down until power is restored. To preserve the energy measurement across power outages, the meter writes the energy to non-volatile (ferroelectric RAM) memory every second. When power returns, the last stored value is recovered.

Energy Sum, Total Net Energy NR

Energy Sum is the net real energy sum of all active phases, where "net" means negative energy will subtract from the total. This value is appropriate for net metering applications (i.e. photovoltaic) where you wish to measure the net energy in situations where you may sometimes consume energy and other times generate energy. Use **Positive Energy Sum** instead if you don't want negative energy to subtract from the total.

Energy Sum is reset to zero when "1" is written to the ***ZeroEnergy (1620)*** register.

The **Total Net Energy NR** is identical to **Energy Sum** except that it cannot be reset to zero.

Positive Energy Sum
Total Positive Energy Sum NR

Positive Energy Sum is equivalent to a traditional utility meter that can only spin in one direction. Every second, the measured real energies for each active phase are added together. If the result is positive, it is added to **Positive Energy Sum**. If it is negative, then **Positive Energy Sum** is left unchanged.

Positive Energy Sum is reset to zero when "1" is written to the ***ZeroEnergy (1620)*** register.

The **Positive Energy Sum NR** is identical to **Positive Energy Sum** except that it cannot be reset to zero.

Power Registers

Power, Phase A
Power, Phase B
Power, Phase C

The Watt-Link™ meter measures real power (watts) for each phase (**Power, Phase A**, **Power, Phase B**, **Power, Phase C**). The measured power is generally positive, but may also be negative, either because you are generating power (such as with solar panels), or because the meter isn't connected properly.

The integer power registers are scaled by ***PowerIntScale (1609)*** to prevent overflow. The integer power registers can only report values from -32767 to +32767. To allow for large power values, PowerIntScale acts as a multiplier to multiply by 1, 10, 100, or 1000. See **Configuration Registers** below for details. To scale the integer **Power, Phase A**, **Power, Phase B**, **Power, Phase C**, or **Power Sum** to watts, use the following equation:

Power(W) = Power Sum • PowerIntScale

For example, if ***PowerIntScale (1609)*** is 100, and the integer **Power Sum** reports 2500, then the power sum is 2500 * 100 = 250,000 W (or 250 kW).

Power Sum

This is the sum of the real power for active phases (line voltage above 20% of nominal). This can include negative values, so if one phase is negative, it will reduce the reported **Power Sum**.

Voltage Registers

All integer voltage registers are reported in units of 0.1 VAC, so 1234 = 123.4 VAC.

Average Line to Neutral Voltage

This is the average line-to-neutral voltage (average of **Voltage, Phase A**, **Voltage, Phase B**, and **Voltage, Phase C**). Only active phases are included (phases where the voltage is above 20% of nominal).

Voltage, Phase A
Voltage, Phase B
Voltage, Phase C

These are the RMS AC voltages for each phase, measured relative to the neutral connection on the meter. If neutral is not connected, then they are measured relative to the ground connection.

Voltage phases that are not connected may report small random voltages, but the Watt-Link™ meter treats any phase reporting less than 20% of the nominal VAC as inactive and will not measure power or energy on inactive phases.

Average Line to Line Voltage

This is the average line-to-line voltage (average of **Voltage, Phase A to B**, **Voltage, Phase B to C**, and **Voltage, Phase A to C**). All phases are included in the average.

Voltage, Phase A to B
Voltage, Phase B to C
Voltage, Phase A to C

The Watt-Link™ meter cannot directly measure line-to-line voltages. It provides these registers as estimates of the line-to-line voltage. In order to estimate these voltages, the meter must know the phase offset or the type of electrical service (see **PhaseOffset (1619)** configuration register).

Frequency

Frequency

The Watt-Link™ meter measures the AC line frequency in Hertz. The integer **Frequency** register reports the frequency in units of 0.1 Hz. All phases must have the same line frequency; otherwise this value will be erratic or incorrect.

Advanced Registers

Per-Phase Energy Registers

Energy, Phase A
Energy, Phase B
Energy, Phase C

The per-phase energy registers report the net real energy for each phase, where “net” means negative energy will subtract from the total. This value is appropriate for net metering applications (i.e. photovoltaic) where you wish to measure the net energy in situations where you may sometimes consume energy and other times generate energy.

These values are reset to zero when “1” is written to the **ZeroEnergy (1620)** register. You may also reset them to zero or load preset values by writing to these registers.

Positive Energy

Positive Energy, Phase A
Positive Energy, Phase B
Positive Energy, Phase C

The per-phase positive energy registers measure the positive real energy for each phase. Negative energy is ignored (instead of subtracting from the total). Energy is measured once per second, so the determination of whether the energy is positive is based on the overall energy for the second.

These values are reset to zero when “1” is written to the **ZeroEnergy (1620)** register. You may also reset them to zero or load preset values by writing to these registers.

Negative Energy

The negative energy registers are exactly like the positive energy registers except they accumulate negative energy. The reported energy values will be positive. In other words, if the Watt-Link™ measures 1000 kWh of negative energy, **Negative Energy, Sum of Active Phases** will report 1000 (not -1000).

The negative energy registers are reset to zero (except for **Negative Energy, Sum of Active Phases NR**) when "1" is written to the **ZeroEnergy (1620)** register. You may also reset them to zero or load preset values (except for **Negative Energy, Sum of Active Phases NR**) by writing to these registers.

Negative Energy, Sum of Active Phases

Every second, the measured real energies for each active phase are added together. If the result is negative, it is added to **Negative Energy, Sum of Active Phases**. If it is positive, then **Negative Energy, Sum of Active Phases** is left unchanged.

Negative Energy, Sum of Active Phases NR

The **Negative Energy, Sum of Active Phases NR** is identical to **Negative Energy, Sum of Active Phases** except that it cannot be reset to zero.

Negative Energy, Phase A
Negative Energy, Phase B
Negative Energy, Phase C

These are the per-phase negative real energy registers.

Reactive Energy

Reactive Energy, Sum of Active Phases
Net Reactive Energy, Phase A
Net Reactive Energy, Phase B
Net Reactive Energy, Phase C

Reactive energy is also known as kVAR-hours. Inductive loads, like motors, generate positive reactive power and energy, while capacitive loads generate negative reactive energy. These are all bidirectional registers that can count up or down depending on the sign of the reactive power.

The Watt-Link™ meter only measures the fundamental reactive energy, not including harmonics.

These values are reset to zero when "1" is written to the **ZeroEnergy (1620)** register. You may also reset them to zero or load preset values by writing to these registers.

Apparent Energy

Apparent Energy, Sum of Active Phases
Apparent Energy, Phase A
Apparent Energy, Phase B
Apparent Energy, Phase C

Apparent energy (kVA-hours) is the accumulation of apparent power over time. The apparent power is essentially the RMS voltage multiplied by the RMS current for each phase. For example, if you have 120 VAC RMS, 10 amps RMS, one phase, the apparent power will be 1200 VA. At the end of an hour, the apparent energy will be 1.2 kVA-hour. Apparent energy is always positive.

The Watt-Link™ meter's apparent energy includes real harmonics, but not reactive harmonics.

These values are reset to zero when "1" is written to the **ZeroEnergy (1620)** register. You may also reset them to zero or load preset values by writing to these registers.

Power Factor

The power factor is the ratio of the real power to the apparent power. Resistive loads, like incandescent lighting and electric heaters, should have a power factor near 1.0. Power-factor corrected loads, like computers, should be near 1.0. Motors can have power factors from 0.2 to 0.9, but are commonly in the 0.5 to 0.7 range.

If the power for a phase is negative, the power factor will also be negative. The reported power factor will be 1.0 for any phases measuring zero power, and will be 0.0 for any inactive phases (line voltage below 20% of nominal VAC).

The Watt-Link™ meter measures the displacement or fundamental power factor, which does not include harmonics.

Integer power factor registers are reported in units of 0.01, so 85 equals a power factor of 0.85.

Power Factor, Phase A
Power Factor, Phase B
Power Factor, Phase C

These are the power factor values for each phase.

Average Power Factor

This is the average power factor, computed as **PowerSum / ApparentPowerSum**.

Reactive Power

Reactive power is also known as VARs. Inductive loads, like motors, generate positive reactive power, while capacitive loads generate negative reactive power. Reactive power transfers no net energy to the load and generally is not metered by the utility. Loads with high reactive power relative to the real power will tend to have lower power factors. The integer reactive power registers are scaled by **PowerIntScale**.

The Watt-Link™ meter only measures the fundamental reactive power, not including harmonics.

To scale the integer **Reactive Power, Phase A**, **Reactive Power, Phase B**, **Reactive Power, Phase C**, or **Reactive Power Sum** to VARs, use the following equation:

PowerReac(VAR) = Reactive Power Sum • PowerIntScale

For example, if **PowerIntScale (1609)** is 100, and the integer **Reactive Power Sum (1343)** reports 1500, then the reactive power sum is 1500 * 100 = 150,000 VAR (or 150 kVAR).

Reactive Power, Phase A
Reactive Power, Phase B
Reactive Power, Phase C

These are the per-phase reactive power measurements.

Reactive Power Sum

The **Reactive Power Sum** is the sum of the reactive power of active phases. This can include negative values, so if one phase is negative, it will reduce the reported **Reactive Power Sum**.

Apparent Power

Apparent power (VA) can be described three ways:

- The RMS voltage multiplied by the RMS current.
- The square root of the real power squared plus the reactive power squared.
- The absolute value or magnitude of the complex power.

The Watt-Link™ meter's measurement of apparent power includes real, but not reactive harmonic apparent power content.

Apparent power is always a positive quantity. The integer apparent power registers are scaled by **PowerIntScale**.

Apparent Power, Phase A
Apparent Power, Phase B
Apparent Power, Phase C

These are the per-phase apparent power measurements.

Apparent Power Sum

The **Apparent Power Sum** is the sum of apparent power for active phases.

Current

The Watt-Link™ Modbus meter estimates the RMS current for each phase. This is an indirect measurement and does not include all harmonic content, so the current is not as accurate as the power and energy measurements.

Current, Phase A
Current, Phase B
Current, Phase C

Technically, AC current does not have a sign (positive or negative), but the Watt-Link™ meter sets the sign of the current to match the sign of the real power for the same phase. For example, if the power on phase A is negative, then the current for phase A (**Current, Phase A**) will also be negative.

The floating point current registers are in units of amps. The integer current registers are in scaled amps (**CurrentIntScale (1622)**, default value 20000), so the following equations will convert to amps.

Ia = Current, Phase A * CtAmpsA / CurrentIntScale
Ib = Current, Phase B * CtAmpsB / CurrentIntScale
Ic = Current, Phase C * CtAmpsC / CurrentIntScale

For example, with 200 amp current transformers and **CurrentIntScale** = 20000, if **Current, Phase A (1351)** reports 5000, the actual current is 5000 * 200 / 20000 = 50.00 amps.

Demand

Demand is defined as the average power over a specified time interval. Typical demand intervals are 5, 10, 15 (default), 30, 60, etc. up to 720 minutes, but the Watt-Link™ meter supports arbitrary demand intervals from 1 to 720 minutes (12 hours). The meter records the peak demand for metering applications where the measurements may only be accessed weekly or monthly.

Since the Watt-Link™ meter can measure bidirectional power (positive and negative), and the demand is the average power over an interval, demand can also be positive or negative. This is only likely to occur with something like a grid-tied PV system, where you may put energy back into the grid at certain times of the day (negative power). In this case, you would see negative demand. If you have both positive and negative power during a demand interval, both the positive and the negative data will be averaged together, such that the negative power subtracts from the positive, reducing the overall demand.

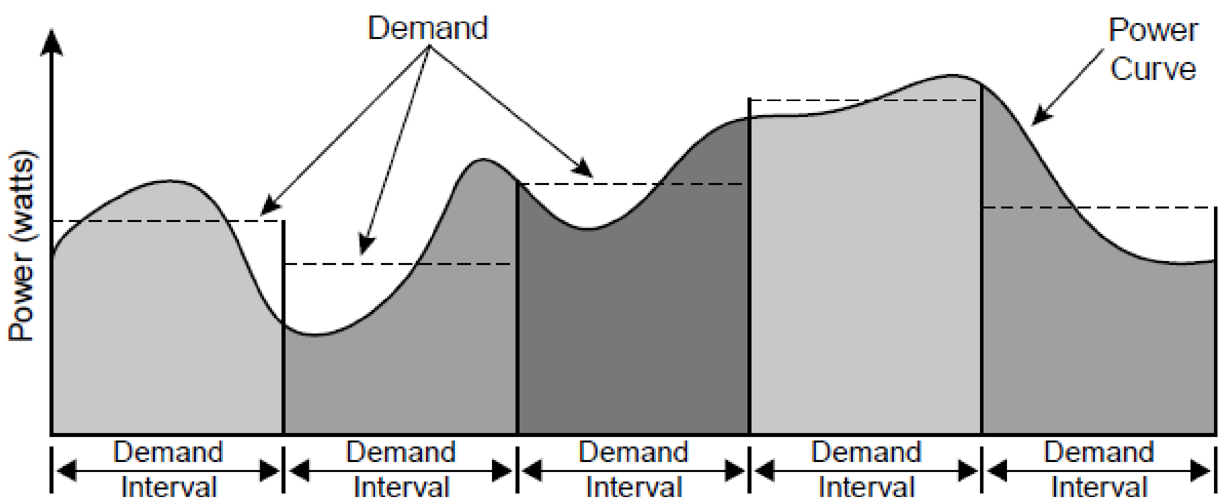

Figure 5. Demand Measurement

Watt-Link™ meters also support rolling demand (also called "sliding window"), in which the demand intervals are evenly divided into a fixed number of subintervals. At the end of each subinterval, the average power over the demand interval is computed and output. This results in better accuracy, especially for demand peaks which would not have lined up with the demand interval without subintervals. On power up, the demand measurements will report zero until one full demand interval is completed. From 1 to 10 subintervals are supported. A subinterval count of one (or zero) results in the standard demand measurement without rolling demand. See **Configuration Registers** below for information on configuring the demand.

Any changes to the demand configuration (**DemPerMins**, **DemSubints**) or CT configuration (**CtAmps**, **CtAmpsA**, **CtAmpsB**, **CtAmpsC**, **CtDirections**) will zero the reported demand and start a new demand measurement. The **Min Demand** and **Max Demand** will not be reset by configuration changes.

To manually zero some or all of the demand registers, see the **ZeroDemand (1621)** register in **Configuration Registers** below.

The floating point demand registers are reported in units of watts, while the integer demand registers must be scaled by **PowerIntScale** to compute watts. To scale the integer **Real Power Demand Average**, **Demand, Phase A**, **Demand, Phase B**, **Demand, Phase C**, **Min Demand**, **Max Demand**, or **Apparent Power Demand**, use the following equation:

Demand(W) = Real Power Demand Average • PowerIntScale

For example, if **PowerIntScale (1609)** is 100, and the integer **Demand (1354)** reports 4700, then the demand is 4700 * 100 = 470,000 watts (or 470 kW).

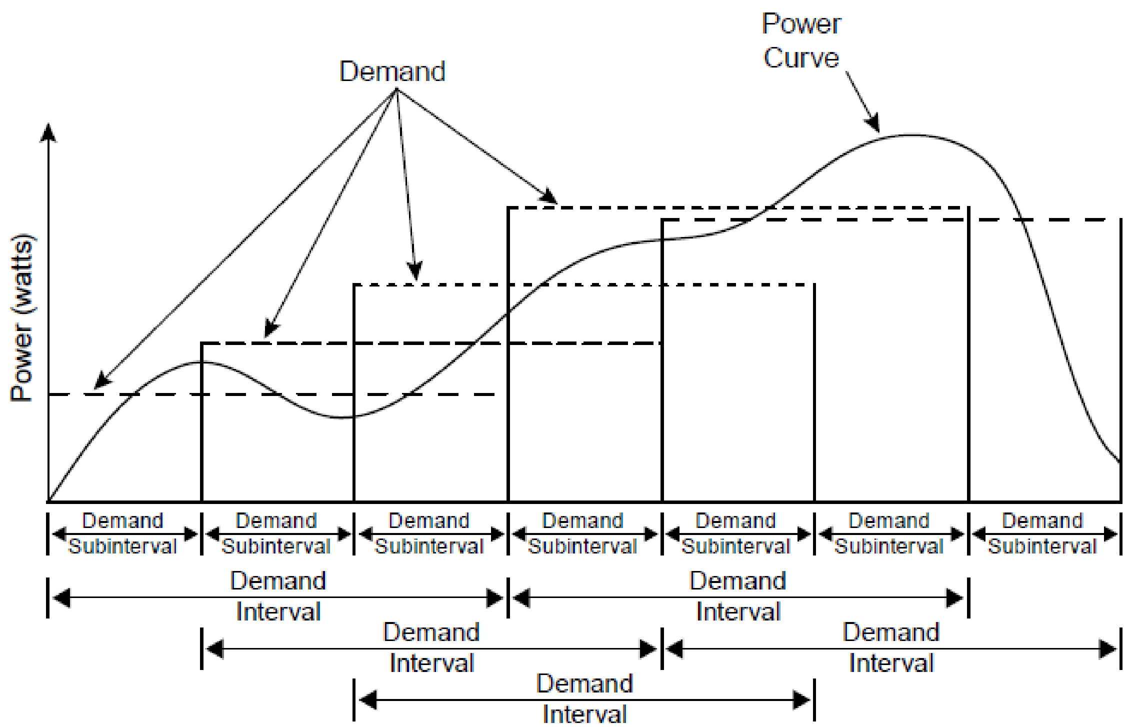

Figure 6. Rolling Demand with Three Subintervals

Real Power Demand Average

The **Real Power Demand Average** register is updated at the end of every subinterval with the average **Power Sum** over a full demand interval. After a power cycle or configuration change, **Real Power Demand Average** will report zero until the completion of one full demand interval.

Demand, Phase A
Demand, Phase B
Demand, Phase C

The real power demand is computed for each phase from **Power, Phase A**, **B**, and **C**.

Min Demand

The **Min Demand** is the smallest measured **Real Power Demand Average** (this may be negative for systems with power generation). It is preserved across power failures and can be reset with the **ZeroDemand (1621)** register. Note: there are no minimum or maximum demand registers for **Demand, Phase A**, **Demand, Phase B**, and **Demand, Phase C**.

Max Demand

The **Max Demand** is the largest measured **Real Power Demand Average**. It is preserved across power failures and can be reset with the **ZeroDemand (1621)** register.

Apparent Power Demand

Apparent Power Demand is computed the same way as **Real Power Demand Average**, but using apparent power.

Configuration Registers

CtAmps (1603)

Writing the CtAmps register is a shortcut to quickly set **CtAmpsA**, **CtAmpsB**, and **CtAmpsC** to the same value. If you read **CtAmps** and **CtAmpsA**, **CtAmpsB**, **CtAmpsC** are all identical, then **CtAmps** will return the common value; otherwise it will return 0 (zero) to indicate there is no common value.

CtAmpsA, CtAmpsB, CtAmpsC (1604 , 1605, 1606)

The CT amps registers are integer registers in units of amps used to set the rated current of the attached current transformers (CTs). This allows the use of different CTs on different input phases: **ØA**, **ØB**, and **ØC**. Rated current is the 100% value; the current that results in a 0.33333 VAC output from the CT.

You can order the meter from the factory with the CtAmps preconfigured using Option **CT=xxx** or **Option CT=xxx/yyy/zzz** if there are different CTs on phases A, B, and C. For example, **Option CT=100/100/50** sets **CtAmpsA** = 100, **CtAmpsB** = 100, and **CtAmpsC** = 50.

The specified rated CT amps for each phase (**CtAmpsA**, **CtAmpsB**, and **CtAmpsC**), affect the scaling CurrentIntScale for the integer current registers **Current, Phase A**, **Current, Phase B**, and **Current, Phase C**. See section **Current** above for details.

CtDirections (1607)

On occasion, current transformers are installed with the label “This side towards source” facing the load instead of the source, or with the white and black wires swapped at the meter. If the electrical installer notices this, they can fix it, but sometimes the problem isn’t noticed until the electrician is gone and some or all of the reported power values are unexpectedly negative.

You can correct this with the **CtDirections** register:

- 0 - All CTs normal
- 1 - Flip phase A CT
- 2 - Flip phase B CT
- 4 - Flip phase C CT
- 3 - Flip phase A CT and flip phase B CT
- 5 - Flip phase A CT and flip phase C CT
- 6 - Flip phase B CT and flip phase C CT
- 7 - Flip all CTs (A, B, and C)

Flipping a CT with **CtDirections** will also reverse the status LED indications. So if the status LED for a phase was flashing red and you flip the CT with **CtDirections**, the LED will change to green flashing. This cannot be used to correct for situations where CT phases do not match the voltage phases, such as swapping phases A and B on the current transformer inputs.

Averaging (1608)

The Watt-Link™ includes averaging for these registers: **Power Sum, Power Phase A, Power Phase B, Power Phase C, Average Line to Neutral Voltage, Voltage Phase A, Voltage Phase B, Voltage Phase C, Average Line to Line Voltage, Voltage Phase A to B, Voltage Phase B to C, Voltage Phase A to C, Frequency, Average Power Factor, Power Factor Phase A, Power Factor Phase B, Power Factor Phase C, Reactive Power Sum, Reactive Power Phase A, Reactive Power Phase B, Reactive Power Phase C, Apparent Power Sum, Apparent Power Phase A,**

Apparent Power Phase B, Apparent Power Phase C, Current Phase A, Current Phase B, Current Phase C.

Averaging is beneficial because it reduces measurement noise, and if the Watt-Link™ is being polled less often than once a second (say once a minute), then the average over the last minute provides a more accurate reading than just the data from the last second, which might be randomly high or low. Averaging is configured by setting the **Averaging (1608)** register to one of the following values:

Table 18. Averaging Settings

Averaging Register	Description	Averaging Period	Update Rate
0	Fastest	1 second	Every 1 second
1	Fast (default)	5 seconds	Every 1 second
2	Medium	20 seconds	Every 4 seconds
3	Slow	60 seconds	Every 12 seconds

When medium or slow averaging are specified, the reported values for averaged registers will only update every 4 or 12 seconds respectively, instead of once a second.

PowerIntScale (1609)

In order to report power as an integer value (±32,767), the meter must scale the power so that it doesn't overflow. By default, the Watt-Link™ meter selects a **PowerIntScale** value of 1, 10, 100, or 1000 whenever the **CtAmps** (or **CtAmpsA**, **CtAmpsB**, or **CtAmpsC**) are changed. The meter selects a value that won't overflow unless the power exceeds 120% of full-scale.

Table 19. PowerIntScale Settings

PowerIntScale	Power Resolution	Maximum Power Reading
0 (default)	Auto-configure	Varies
1	1 Watt	±32767 W
10	10 Watt	±327.67 kW
100	100 Watt	±3276.7 kW
1000	1000 Watt	±32767 kW
Custom Values	PowerIntScale 1W	±(PowerIntScale • 32767 W)

You may also choose your own custom value for **PowerIntScale** including values that are not multiples of 10.

If **PowerIntScale** is set to auto-configure, then reading **PowerIntScale** will show the actual scale factor instead of 0.

To compute the actual power from integer power registers, use the following equation (note, there is no scaling for the floating-point power registers, which always report power in watts):

ActualPower(W) = PowerRegister • PowerIntScale

PowerIntScale is used with the following registers: **Power Sum, Power Phase A, Power Phase B, Power Phase C, Reactive Power Sum, Reactive Power Phase A, Reactive Power Phase B, Reactive Power Phase C, Apparent Power Sum, Apparent Power Phase A, Apparent Power Phase B, Apparent Power Phase C, Real Power Demand Average, Min Demand, Max Demand, Apparent Power Demand**.

CurrentIntScale (1622)

When reporting current values as integers, the Watt-Link™ meter scales the current values so that a current equal to the CT rated amps will result in an output value of **CurrentIntScale**. The default **CurrentIntScale** is 20000. See **Current** for more details.

Demand Configuration

DemPerMins, DemSubints (1610, 1611)

The variable **DemPerMins** sets the demand interval in minutes (default 15 minutes), and **DemSubints** sets the number of demand intervals (default 1). The time period of each subinterval is the demand interval divided by the number of subintervals. Setting **DemSubints** to 1 disables subinterval computations. The demand period cannot be longer than 12 hours (720 minutes), and a demand subinterval cannot be less than 1 minutes. The **DemSubints** can be set from 1 to 10.

An example configuration could use a demand period of 60 minutes with 4 subintervals. This would result in a subinterval period of fifteen minutes. Every fifteen minutes, the average power over the last hour would be computed and reported.

GainAdjustA, GainAdjustB, GainAdjustC (1612, 1613, 1614)

You may need to adjust the Watt-Link™ meter to match the results from a reference meter (such as the utility meter) or to correct for known current transformer errors. The **GainAdjust** registers effectively adjust the power, energy, and current calibration or registration for each phase.

The default values for the **GainAdjust** registers are 10,000, resulting in no adjustment. Setting the value to 10,200 increases all the power, energy, and current readings from the meter by 2% (10,200 / 10,000 = 102%). Setting the value to 9,800 decreases the readings by 2% (9,800 / 10,000 = 98%). The allowed range is from 5,000 to 20,000 (50% to 200%).

PhaseAdjustA, PhaseAdjustB, PhaseAdjustC (1615, 1616, 1617)

For maximum accuracy, there may be cases where you wish to compensate for the phase angle error of the current transformers you are using. The **PhaseAdjust** registers allow the phase angle to be adjusted on each phase by up to ±8 degrees in increments of one millidegree. For example, if your CT causes a phase lead of 0.6 degrees (or 36 minutes), you could correct for this by setting **PhaseAdjustA**, **B**, and **C** to -600, which subtracts 600 millidegree or 0.6 degree from the phase lead. Use negative values to compensate for a phase lead in the CT (most common).

The default adjustment is -1000; this corrects for a one degree phase lead in the CT. Since our CTs typically have phase leads ranging from 0.2 degrees to 2.5 degrees, the default adjustment improves the typical performance.

CreepLimit (1618)

Creep refers to the situation where the wheel on an traditional electro-mechanical energy meter moves even though there is no power being consumed. The Watt-Link™ meter has no wheel, but all electrical systems have some noise, which can cause small readings in the absence of any power consumption. To prevent readings due to noise, if the readings fall below the creep limit, the meter forces the real and reactive power values to zero, and stops accumulating energy. This is performed independently for each measurement phase using the following equation.

MinimumPower = FullScalePower / CreepLimit

Any measured power or reactive power below MinimumPower is forced to zero. FullScalePower is defined as the nominal line-to-neutral VAC (see Table 11 in the Watt-Link™ Installation Guide) multiplied by the full-scale or rated CT current.

Generally, the default value of 1500 (which sets the creep limit to 1/1500th of full-scale power) works well. Sometime, in electrically noisy environments, you may see non-zero power readings when the power should be zero. You can adjust the creep limit to eliminate this problem. For example, to adjust the creep limit to 1/500th of full-scale (0.2%), set **CreepLimit** to 500.

PhaseOffset (1619)

The Watt-Link™ meter cannot directly measure line-to-line voltages (**Voltage, Phase A to B, Voltage, Phase B to C, Voltage, Phase A to C, Average Line to Line Voltage**). To estimate these voltages, the meter must know the phase offset of the electrical service being measured. This setting has no effect on any other measurements or registers and is only needed if you plan to monitor the line-to-line voltages.

Table 20. Phase Offset Values

PhaseOffset (degrees)	Electrical Service Type
0	Single-phase (all line-to-line voltages will read zero). Use this setting when monitoring multiple independent branch circuits
60	Three-phase grounded delta (grounded leg), where one phase is connected to earth (rare)
90	Four-wire delta (wild leg): 120/208/240
120 (default)	Three-phase: 120/208, 230/400, 277/480, 347/600
180	Single-phase three-wire (mid-point neutral): 120/240 **Voltage, Phase A to B** will report the line-to-line voltage. **Voltage, Phase B to C** and **Voltage, Phase A to C** will report zero regardless of the actual phase C voltage.

Zeroing Registers

ZeroEnergy (1620)

Writing 1 to **ZeroEnergy** will simultaneously set all of the energy registers to zero, except those ending in “NR” (for non-resettable). They can also be set to zero or a preset value by writing the desired value directly to each energy register.

As a security measure, there are three non-resettable energy registers that can never be reset to zero:

Energy Sum, Total Net Energy NR
Negative Energy, Sum of Active Phases NR
Total Positive Energy NR

ZeroDemand (1621)

The **ZeroDemand** register can be written with three values (or zero which does nothing).

- **1** - Zero **Min Demand** and **Max Demand** registers.
- **2** - Zero **Real Power Demand Average**, **Demand, Phase A**, **Demand, Phase B**, **Demand, Phase C** and **Apparent Power Demand** registers. Start a new demand interval.
- **3** - Zero **Min Demand**, **Max Demand**, **Real Power Demand Average**, **Demand, Phase A**, **Demand, Phase B**, **Demand, Phase C** and **Apparent Power Demand** registers. Start a new demand interval.

Diagnostic Registers

UptimeSecs (1703, 1704)

This 32 bit long integer counts the number of seconds the meter has been running since the last power failure or reset. Resets can be caused by power brownouts or severe errors.

TotalSecs (1705, 1706)

This 32 bit long integer counts the total seconds of meter operation since factory calibration.

Model (1707)

This register can be used to determine the Watt-Link™ model.

- **201** –Watt-Link-LXRS 3Y-208
- **202** - Watt-Link-LXRS 3Y-400
- **203** - Watt-Link-LXRS 3Y-480
- **204** - Watt-Link-LXRS 3Y-600
- **205** - Watt-Link-LXRS 3D-240
- **206** - Watt-Link-LXRS 3D-400
- **207** - Watt-Link-LXRS 3D-480

PowerFailCount (1711)

This counts (up to 32767) the number of times power has been cycled on this meter.

Communication Error Counts

The following four registers report communication error counts. Each register counts up to 32767 and stops. All four of these registers are reset to zero whenever power is cycled or by writing zero to any of them.

CrcErrorCount (1712)

This counts (up to 32767) the number of Modbus packets with an invalid CRC (cyclic redundancy check).

FrameErrorCount (1713)

This counts (up to 32767) the number of Modbus packets with framing errors. A framing error can indicate bad baud rate, bad parity setting, noise or interference.

PacketErrorCount (1714)

This counts (up to 32767) the number of Modbus packets that could not be parsed.

OverrunCount (1715)

This counts (up to 32767) the number of times the input buffer has been overrun. The buffer is 256 bytes and normal requests are less than 80 bytes, so an overrun normally indicates severe noise on the bus.

Error Codes

ErrorStatus (1710)
ErrorStatus1 - ErrorStatus8 (1716 - 1723)

The ErrorStatus registers hold queues of the most recent eight errors or status notifications.

ErrorStatus allows access to the eight most recent errors from a single Modbus register. Each time you read it, you'll get another value (starting with the oldest). When there are no more errors, **ErrorStatus** will report 0. The **ErrorStatus** values are preserved across power failures. **ErrorStatus** is generally best used with unattended data logging, since each error will only be reported once.

ErrorStatus1 through **ErrorStatus8** also list the eight most recent errors, but with a few differences. **ErrorStatus1** lists the most recent error or status, while **ErrorStatus8** lists the oldest. Reading these registers won't change the reported values for **ErrorStatus1** through **ErrorStatus8**, so they can be read repeatedly without clearing the values. **ErrorStatus1** through **ErrorStatus8** can all be cleared by writing 0 to any of them. They are **not** preserved across power failures. **ErrorStatus1** through **ErrorStatus8** are generally best used when a person will be looking at the values in real time, because they provide a visual history of recent errors and events and will not be cleared when they are read.

The following lists many of the error and status code values. For any not listed or those marked "ERROR" contact technical support.

- **0**: No error or status messages.
- **1-49**, **50-58**, **60-61**, **71-73**: ERROR: Internal firmware error. Contact technical support.
- **59**: ERROR: Non-volatile data lost: energy, peak demand, etc.
- **62-66**: WARNING: Internal energy measurement overflow
- **67**: ERROR: Calibration data lost. Meter will not function until it is recalibrated.
- **68**: ERROR: Configuration data lost (CtAmps, etc.)
- **69**: WARNING: Could not measure AC line frequency, may indicate high noise condition.
- **70**, **74**: ERROR: Non-volatile memory failure: energy, demand, etc. will be lost when power fails.
- 7**5-77**: ERROR: Internal measurement error.
- **78-83**: WARNING: Measured high AC line voltage. Sustained high voltage may damage the Watt-Link™.
- **84**, **85**, **86**: INFO: ***Energy, Phase A, B, C*** registers overflowed 100 gigawatt-hours, reset to 0.
- **87**: INFO: ***Energy Sum*** register overflowed 100 gigawatt-hours, reset to 0.
- **88**: INFO: ***Total Net Energy NR*** register overflowed 100 gigawatt-hours, reset to 0.
- **89**, **90**, **91**: INFO: ***Net Reactive Energy, Phase A, B, C*** registers overflowed 100 gigawatt-hours, reset to 0.
- **92**: INFO: ***Reactive Energy, Sum of Active Phases*** register overflowed 100 gigawatt-hours, reset to 0.
- **93**, **94**, **95**: INFO: ***Positive Energy, Phase A, B, C*** registers overflowed 100 gigawatt-hours, reset to 0.
- **96**: INFO: ***Energy Positive Sum*** register overflowed 100 gigawatt-hours, reset to 0.
- **97**: INFO: ***Total Positive Energy NR*** register overflowed 100 gigawatt-hours, reset to 0.
- **98**, **99**, **100**: INFO: ***Negative Energy, Phase A, B, C*** registers overflowed 100 gigawatt-hours, reset to 0.
- **101**: INFO: ***Negative Energy, Sum of Active Phases*** register overflowed 100 gigawatt-hours, reset to 0.
- **102**: INFO: ***Negative Energy, Sum of Active Phases NR*** register overflowed 100 gigawatt-hours, reset to 0.
- **103**, **104**, 105: INFO: ***Apparent Energy, Phase A, B, C*** registers overflowed 100 gigawatt-hours, reset to 0.

- **106**: INFO: ***Apparent Energy, Sum of Active Phases*** register overflowed 100 gigawatt-hours, reset to 0.
- **197**: WARNING: Tried to write to read-only register.
- **206**: WARNING: Invalid register address specified.
- **207**: WARNING: Invalid register data value specified.
- **208**: WARNING: Invalid configuration register value specified.
- **211**: WARNING: Invalid write length specified.
- **212**: WARNING: Invalid single-register write length specified
- **213**: WARNING: Invalid function code specified.
- **216**: ERROR: Custom register map error. Custom map disabled.
- **220**: INFO: Factory reset of energies completed.
- **242**, **246**: WARNING: Packet collision. The meter received extra data after receiving a command. This may indicate an address conflict or electrical interference.
- **243**: WARNING: Invalid Modbus message length.
- **247**: WARNING: Parity error. Generally caused by baud rate mismatch, parity mode mismatch, or electrical interference.
- **248**: WARNING: Bus contention during transmit.
- **249**: WARNING: Duplicate address detected.
- **250**: WARNING: Receiver overrun.
- **251**: WARNING: Receiver error. Generally caused by baud rate mismatch, parity mode mismatch, or electrical interference.
- **252-253**: WARNING: Short packet detected (less than four bytes).
- **254**: WARNING: False start bit. This generally indicates electrical noise, or inadequate termination or biasing.
- **255**: WARNING: Invalid packet cyclic redundancy check (CRC). This generally indicates electrical noise on the bus.

Maintenance and Repair

The Watt-Link™ Modbus meter requires no maintenance. There are no user serviceable or replaceable parts except the pluggable screw terminals.

The Watt-Link™ meter should not normally need to be cleaned, but if cleaning is desired, power must be disconnected first and a dry or damp cloth or brush should be used.

The Watt-Link™ meter is not user serviceable. In the event of any failure, the meter must be returned for service (contact LORD MicroStrain® for an RMA). In the case of a new installation, follow the diagnostic and troubleshooting instructions before returning the meter for service, to ensure that the problem is not connection related.

Chapter 4 - Limitation of Liability

BUYER ACKNOWLEDGES AND AGREES THAT THE WATT-LINK PRODUCTS (THE “PRODUCTS”) MUST BE INSTALLED ONLY BY A LICENSED ELECTRICIAN AUTHORIZED TO CONDUCT BUSINESS IN THE JURISDICTION IN WHICH THE PRODUCTS ARE TO BE INSTALLED. IN ADDITION, BUYER AGREES THAT SELLER SHALL HAVE NO LIABILITY WHATSOEVER FOR ANY DAMAGES RESULTING FROM THE INSTALLATION OF A PRODUCT BY ANY PERSON THAT IS NOT A LICENSED ELECTRICIAN IN THE JURISDICTION IN WHICH THE PRODUCT IS INSTALLED. FURTHERMORE, REGARDLESS OF WHETHER THE PERSON THAT IS INSTALLING A PRODUCT IS A LICENSED ELECTRICIAN, BUYER AGREES THAT SELLER SHALL NO LIABILITY WHATSOEVER IN CONNECTION WITH ANY DAMAGES RESULTING (i) DURING THE INSTALLATION OF THE PRODUCT AND/OR (ii) FROM THE IMPROPER INSTALLATION OF THE PRODUCT.

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