Southern Company
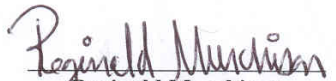
Southern Company Specification for
Single Phase and Polyphase
FlexNet® Compatible
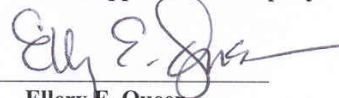## Electronic AMI Meters

June 3, 2008

Specification #SES-PD-146

Approved:

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1.0   SCOPE

1.1   This specification covers the electrical, mechanical and environmental characteristics of solid-state electronic meters, 2, 3, or 4-wire, 120, 240, or 277-volt, either class 200 or class 320 (self-contained) and Class 20 (transformer-rated), provided with FlexNet® communications and used for revenue metering purposes.

1.2   All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with American National Standards Institute (ANSI) Standards C12.1 and C12.10. All references to ANSI Standards refer to the latest published edition.

1.3   This specification applies to meters that function as kWh or kWh/kW. In addition to functioning as a kWh/kW meter, the meter shall function as a Time of Use (TOU) meter or mass memory device with load profile. Operation without an internal battery is required.

Further, the meter shall be capable of being upgraded to kVarh/kVar or kVAh/kVA capability via the FlexNet® network using software upgrade capability.

1.4   The meter shall be applicable to the following services for its respective class and form including but not limited to:

Form 1S	120 Volt 2 Wire
Form 2S	240 Volt 3 Wire
Form 3S	120 Volt 2 Wire
Form 4S	240 Volt 3 Wire
Form 5S	120/240 Volt 3 Wire
Form 8/9S	120V, 4 Wire Wye; 277V, 4 Wire Wye; 240V, 4 Wire Delta.
Form 12S	120/240 Volt 3 Wire
Form 15/16S	120V, 4 Wire Wye; 277V, 4 Wire Wye; 240V, 4 Wire Delta
Form 26S	120 Volt 3 Wire

ALL meter forms listed above shall be available. The meter supplier shall provide a complete list of all available meter forms and service types currently in production. In the event that any forms listed in this section are unavailable, a detailed engineering and manufacturing production schedule shall be provided.

2.0   ACCURACY AND TESTING

2.1　　The meter shall meet or exceed the requirements for 0.2% accuracy class as stipulated in ANSI C12.20 applicable to Blondel meters. Non-Blondel meters such as Form 2S residential meters shall be certified to 0.2% accuracy or better under balanced conditions. Performance documentation shall be provided.

2.2　　The manufacturer shall test and calibrate each meter at full load, light load and power factor. Meters shall perform within stated accuracy standards as shown in **Attachment II**, *SoCo Meter Acceptance Criteria*, dated July 1, 2007.

2.3　　The register shall display energy and demand measurements within a minimum of +/- two pulse accuracy.

2.4　　Each system operating company may conduct tests to determine compliance with Section 2.1.

3.0　　COVER AND SEAL

3.1　　COVER

　　3.1.1　　Meter Covers shall be molded polycarbonate or Lexan®. If equipped with a metal ring, the ring shall be stainless steel. Non-traditional meter and meter cover designs must be approved by Southern Company.

　　3.1.2　　The meter may include a GE Opticom® port or equivalent, in compliance with ANSI C12.10 and C12.18. This port may also be utilized in scrolling the displayed quantities as well as for testing purposes. The port shall be mounted on the front of the meter with no hard-wired connector to the cover. The external portion of the optical port assembly shall be constructed from a non-corrosive material, maintaining the necessary magnetic properties.

3.2　　SEAL

All meters shall be sealed (base plate to cover) with a "T-bar" seal stamped with the manufacturer identification marking.

4.0   METER CHARACTERISTICS

4.1   ENVIRONMENTAL

4.1.1   Humidity

The meter shall function from 0 to 95 percent relative humidity, non-condensing.

4.1.2   Temperature

The meter, including all internal devices, modules and components provided under the cover shall operate normally within the temperature range from -40 degrees C to +85 degrees C.

4.1.3   Life Expectancy

The meter, including all internal devices, modules and components provided under the cover shall operate normally for a period of no less than 20 years of in service life, as indicated by accelerated life cycle test results performed by the manufacturer. Such results shall be provided to Southern Company for review.

4.1.4   Product Reliability -Device Defect Rate

The meter, including all internal devices, modules and components provided under the cover shall perform per manufacturer's stated specifications such that the annual defect failure rate of product in service shall not exceed 0.4% of the installed population**. Each month, an annualized failure rate will be calculated. The equation used to calculate this failure rate will be: [Total failures for a current month/Total numbers installed to date] * 12.** Failure to meet this standard of reliability shall result in warranty returns, required remedial action by the vendor, or possible removal from the approved supplier list.

4.2   ELECTRICAL

4.2.1   The meter shall operate between -15% to +10% of the rated voltage and $\pm$ 3 Hz of the rated frequency.

4.2.2   The meter shall be designed to pass the electrical test requirements as outlined in ANSI C12.1 and ANSI C12.20 for electricity meters. In addition, testing should be performed as outlined in **ATTACHMENT I**, *ANSI and IEC Test Specifications*.

4.2.3 Recurring power outages and other electrical phenomena shall not adversely effect the operation of the meter.

4.3 OPERATIONS/MEASUREMENT FUNCTIONS

4.3.1 The meter shall be capable of being programmed for a minimum of four daily rate periods plus a total kW/kWh for each season and shall be capable of a minimum of two seasons per year, three day types, five holidays, weekends, critical peak period, and weekdays. The meter shall have as a minimum four optional rate indicator display IDs to indicate the currently active rate (A, B, C or D) plus an indicator for total consumption.

TABLE I

Minimum Measurements by Meter Type				
Measurement Type	**1 Phase - Standard**	**1 Phase with Upgrade Options**	**Polyphase- Standard**	**Polyphase- with Upgrade Options**
Energy Delivered	X	X	X	X
Demand Delivered	X	X	X	X
Energy Received		X	X	X
Demand Received		X	X	X
Net Energy	X	X	X	X
Time of Use (see above)		X	X	X
Block Demand	X	X	X	X
Rolling Demand	X	X	X	X
Kvarh		X	X	X
Kvah		X	X	X
Kvarh Lead, lag, & total				X
Kvah Lead, lag, & total				X
ANSI C12.19 Set	X	X	X	X
Voltage- Min,				

max, Avg.	X	X	X	X

4.3.2   The meter shall be capable of being programmed for daylight savings time shifts with programmable dates with a minimum 2 year calendar schedule.

4.3.3   <u>Display</u>

The display shall be Liquid Crystal Display (LCD) with minimum 0.4" segments.

4.3.4   <u>Annunciators</u>

Annunciators or "carets" shall identify, as a minimum the following quantities: kWh and Maximum kW since last reset. Identifying codes are permissible for other quantities.

<u>Modes of Operations</u>

There shall be normal, alternate, test and diagnostic modes of register operation. Registers for kWh/kW values are listed. Corresponding values for kVarh/kVar and kVAh/kVA quantities shall be available for meters programmed accordingly. Meters shall be upgradeable as follows:

4.3.5.1 <u>Normal Mode Quantities</u>

The following quantities shall be the minimum and not inclusive of all displays available in normal mode operation. The display and sequence of these items shall be completely programmable. Additional similar metrics may be available for reactive and VA, but must include coincident values as required by Southern Company.

1. Segment Test with Annunciators
2. Kilowatt-hours
3. Maximum Demand
4. Cumulative Demand
5. Continuous Cumulative Demand

<u>Alternate Mode Quantities – Polyphase Meters</u>

Access to the alternate mode quantities shall be gained through a manual switch. The following quantities shall be the minimum and not inclusive of all displays available in alternate mode operation. The display and sequence of these items shall be completely programmable.

1. Kilowatt-hours
2. Maximum Demand
3. Cumulative Demand
4. Continuous Cumulative Demand
5. Number of Demand Resets
6. Programmed Watt-hour Constant
7. Demand Interval Length
8. Demand Subinterval Length
9. Demand Delay
10. Pulse Initiator Ratio
11. End of Interval Indication
12. Full Scale Demand Value
13. Demand Threshold Value
14. Demand Previous Period
15. Number of Power Outages
16. Time on Battery
17. Date
18. Time
19. Firmware Version
20. Current and Previous season Energy consumption for each rate
21. Program ID
22. Software Version
23. Scaler

4.3.5.3 <u>Test Mode Quantities</u>

Test mode shall be accessed by operating a manual switch on the register face. The following quantities shall be the minimum and not inclusive of all displays available in test mode operation. The display and sequence of these items shall be completely programmable.

1. Time Remaining in Interval (subinterval)
2. Present Demand (kW, kVar, kVA)
3. Maximum Demand (kW, kVar, kVA)
4. Input Pulse Count (kW, kVar, kVA)
5. Consumption (kWh, kVarh, kVah)

There shall be a programmable or fixed time-out feature for test mode operation. Test Mode operation shall include a programmable test interval. Test pulses shall be available via a local user interface to be approved by Southern Company.

Diagnostic Mode Operation

The diagnostic mode of operation shall be capable of being activated without breaking the meter seal.

The meter shall be capable of measuring or detecting the following conditions and generating an error condition (programmable to add to the scroll list or lock the display):

1. Individual phase rms voltage information (magnitude and angle)
2. Individual phase rms current information (magnitude and angle)
3. Inactive phase voltage
4. Inactive phase current
5. Polarity, cross phase, and reverse power flow
6. Voltage Sag and Swell
7. Even harmonic (DC alert)

Diagnostic counters shall be available for the referenced conditions.

4.3.7   Display Resolution

The energy and demand displays shall have the decimal point location programmable and should as a minimum have the ability to display as follows:

Energy - XXXXX (five significant digits)
Demand - XXX.XXX (six significant digits)

4.3.7.2 Leading zeros shall be displayed unless programmed to be suppressed.

4.3.8   Demand Interval

4.3.8.1 Demand shall be calculated on either a block or rolling demand interval basis and as a minimum have the following intervals available for use: 15, 30, & 60 minutes

4.3.8.2 Demand subintervals shall be available for each demand interval. The number of subintervals available shall be as follows:

15 minute interval – (minimum of three subintervals)
3 minute subinterval
5 minute subinterval
15 minute subinterval

30 minute interval – (minimum of five subintervals)
    5 minute subinterval
    6 minute subinterval
    10 minute subinterval
    15 minute subinterval
    30 minute subinterval

60 minute interval (minimum of six subintervals)
    10 minute subinterval
    12 minute subinterval
    15 minute subinterval
    20 minute subinterval
    30 minute subinterval
    60 minute subinterval

4.3.8.3   Demand reset shall be accomplished by:

    1. Remote activation via the FlexNet® network.
    2. A season change (optional via a software selection).
    3. Programmable self-read, reset, & storage.

If a local physical demand reset mechanism is provided, then it shall be capable of being disabled by software methods.

4.3.9 Display Scroll Rate

The display shall scroll through selected quantities via manual intervention or automatically at a programmed rate. This rate shall be programmable to a value of from 3-10 seconds in one second increments.

4.3.10 Demand Delay

After a detectable power outage, a demand delay option shall be available. This delay shall be programmable from 0-99 minutes in 1 minute increments.

4.3.11 Security

4.3.11.1   The meter should generate an error flag if inverted in the socket and shall be capable of sending tamper indication back via the communications network.

4.3.11.2   The register shall have a programmable electronic detent feature

4.3.11.3   Local physical connections to the meter shall have a minimum of two levels of security. These levels shall include a read/write password

and a read only password. Security shall be provided for wireless communications using encryption and secure AES key methods.

MEMORY

4.4.1   All data and programmed constants, including mass memory data, shall be stored in non-volatile memory.

4.4.2   The meter shall be equipped with interval profile data recording capability including a minimum of 45 days one channel (single phase), 90 days two channel (polyphase), 15 minutes interval which shall be the minimum net amount of memory available after taking into account any active meter features which may use a portion of the mass memory, e.g., register data, diagnostics, various tables, etc. The interval for the profile data shall be independent of the demand interval and shall be capable of being programmed to at a minimum either a 15, 30, or 60 minute interval.

4.4.3   The polyphase meter shall be capable of two channel ANSI C12.19 sets and shall be capable of lead, lag, and total kvah and kvarh, kwh. All shall be designated delivered or received.

There shall be a validation register available for all assigned load profile channels.

4.4.4   The meter manufacturer shall make available for their respective meter, at no additional cost, the necessary technical data to allow Southern Company, its representatives or other parties, as requested by Southern Company, to develop applications that facilitate communications (either on-site or remotely) for programming, data collection, diagnostic or other purposes.

4.4.5   The meter and radio firmware shall be stored in Flash ROM or equivalent allowing on-site or remote modification of the firmware via the FlexNet® network in order to correct problems or add meter enhancements.

4.5   POWER OUTAGE OPERATION

4.5.1   When a power outage condition is detected by the microprocessor, the programmed constants and register data shall be written to non-volatile memory and be restored upon power return.

4.5.2   Upon restoration of power and FlexNet® network communications to the unit, the unit shall return to normal operation. Vendor shall describe operation of meter in the

event that communications is not immediately restored after restoration of power.

4.5.3 The meter shall be capable of active power outage notification and power restoration via the communications network.

4.6   PULSE OUTPUT CAPABILITY

4.6.1   As an option, the register shall be capable of providing either a Form C or Form A Energy pulse output (kWh, kVarh, kVAh) with a programmable Mp value. An optional EOI (End of Interval) pulse shall also be available.

4.6.2   The pulse output hardware shall be capable of being installed in the field or lab if desired.

4.7   PULSE INPUT CAPABILITY

Where provided, the minimum pulse input shall be ten pulses per equivalent disk revolution.

4.8   DATA TRANSFER

4.8.1   Register energy and demand readings may be entered into a register via a PC or handheld device. The meter shall be capable of accepting a Sensus Flexnet® communications interface or the interface shall be integrated on the manufacturer's metrology board.

4.8.2   Where provided, the meter shall support optical port communications conforming to ANSI C12.18 – Protocol Specification for ANSI Type 2 Optical port.

4.8.3   Each polyphase meter shall support communications using ANSI C12.19 – Utility Industry End Device Data Tables. The table protocol shall follow the latest edition of the AEIC Implementation Guidelines. Southern Company encourages adoption of these industry standards for all meter end device products.

   The meter program files will be developed using manufacturer supplied application software that runs under both the Windows XP and Windows Vista environment.

4.9   PROGRAMMING

4.9.1   As an option, at individual operating company request, meters shall be pre-programmed at the factory using program information supplied by the respective operating company. There shall be no additional cost for pre-programming.

4.9.2   Programming and/or reading software will be provided to each Operating Company as necessary for no additional cost.

4.9.3   If the meter is capable of an upgrade, the security allowing such upgrades will utilize software methods or other similar processes

4.10   ERROR DETECTION

4.10.1 The register shall, periodically, perform self tests to verify the integrity of the stored data and the proper operation of the electronics. The manufacturer shall provide a complete set of diagnostic error codes.

4.10.2 A Full Scale Overflow indication shall also be provided without ceasing register operation.

4.10.3 Additional error messages may be provided at the discretion of the manufacturer. These shall include those listed in the diagnostic mode section.

5.0   NAMEPLATE

5.1   In addition to all data as required by ANSI C12.10, the meter nameplate shall contain all data as required by the Southern System Bar Code Specification. Layout may vary slightly between manufacturers based upon available space. All nameplates must be approved by Southern Company. Use of the Southern Company approved SmartMeter logo on each nameplate is required. A color or grayscale template is available from Southern Company.

A sample faceplate is shown below:

5.2　　Meters shall be company-numbered with the numbering sequence as directed by each operating company.

5.3　　Company numbers and manufacturer's serial numbers shall be sequential within an order.

5.4　　Additional nameplates, barcodes or other markings necessary to identify ancillary devices, cards or modules including FlexNet® radio modules must be approved by Southern Company.

6.0　　RECORD KEEPING AIDS

6.1　　A printout and electronic data file containing the following information shall be provided with each order:

　　1. Manufacturer's Name
　　2. Manufacturer's Catalog Number
　　3. Manufacturer's Order Number
　　4. Date of Manufacture
　　5. Customer Name
　　6. Customer Order Number
　　7. Customer Meter Code
　　8. Quantity in Batch
　　9. First and Last Manufacturer's Serial Numbers in Batch
　　10. First and Last Customer Company Numbers in Batch

6.2　　Individual meter information, including as-left test results, shall be provided in the format specified in **Attachment III –** *SOCO ASCII FILE FORMAT FOR MANUFACTURER'S METER TEST DATA*. The information shall be sent via electronic file transfer to a designated employee at each operating company.

6.3 FlexNet® meter configuration files (marriage files) linking the radio modules to specific meters shall be provided at the time of meter shipment. Contact Sensus for detailed schema and file format necessary.

7.0 BID REQUIREMENTS

7.1 Each manufacturer's quote shall include any deviation from any portions of the specification and the following information:

7.2 Bid Price

7.3 Typical performance data based on manufacturer's production run tests as follows:

1. Watts Loss
2. Starting Watts
3. Temperature Curve
4. Power-Factor Curve
5. Load Curve
6. Voltage Curve

7.4 Lead time as of the date of quotation.

WARRANTY

All meters quoted shall be warranted for a minimum of 5 years. This warranty shall cover repair or replacement due to defects in materials or workmanship, whether hardware, firmware or application software based. This warranty shall also cover any modules provided including FlexNet® radio modules if provided as an integrated product by the supplier.

8.0 PACKAGING AND SHIPPING

8.1 Polyphase meters shall be packed four to a box and shall be palletized 48 per pallet (except for orders less than 48). Optionally, at the operating company request, meters shall be packed one to a box at no additional cost. Single phase meters shall be packed four to a box and shall be palletized 96 per pallet (except for orders less than 96).

8.2 Pallets shall be substantially constructed of suitable material to withstand initial shipment and reuse for reshipment. Pallets shall be, nominally, 44 inches long, 32 inches wide, and not less than five inches high, with not less than four inches of vertical clearance between top and bottom boards. Pallet runners shall be spaced to accommodate both a fork lift and a pallet jack. Pallets and packaging materials

shall be of sufficient strength and design to accommodate stacking a minimum of two pallets high for shipping and for storage.

8.3   All shipments shall be FOB Destination, freight prepaid and allowed.

8.4   All boxes shall be marked as follows:

1. Pallet Number
2. Carton Number
3. Customer Company Numbers of Meter in Box

8.5   Each pallet shall be marked with the customer name and order number.

8.6   Southern Company has a desire to investigate re-usable meter shipping containers if practical. Vendor shall provide options for this for review and approval.

9.0   NON-CONFORMANCE

9.1   The purchasers shall inspect and test each shipment to determine compliance with this specification. Meters shall perform within stated accuracy standards as shown in **Attachment II**, *SoCo Meter Acceptance Criteria*. In addition to accuracy tests, functional tests shall be performed to verify performance using the FlexNet® radio system.

9.2   Meters that do not comply with this specification in its entirety may be rejected and returned at the manufacturer's expense.

Failure to comply with this specification in its entirety may result in the manufacturer's removal from approved supplier lists.

Changed to the design or specifications by the manufacturer shall require prior approval by all Southern System Operating Companies. Meters shipped without approval will be returned at the manufacturer's expense.

Revision June 3, 2008 – Modified Table I per Derl Rhoades comment

ATTACHMENT I

ANSI and IEC Test Specifications

Electronic metering products shall meet the requirements of all applicable industry standards, including, but not limited to the following:

- **ANSI C12.1 - 2001, American National Standard for Electricity Meters – Code for Electricity Metering**

    o **Section 4.7.3.3.2 – 1.2/50 microsecond – 8/20 microsecond combination wave.** (This test is similar to IEC 61000-4-5, Surge Immunity Test.)

    Exception: Product will be tested for Location Category C1 as defined in ANSI C62.41, Table 4.

    Clarification: Product will be tested with six (6) repetition surges at each test point.

    Clarification: Product will be tested at all connection modes as described in ANSI C62.41, Table 4.

    o **Section 4.7.3.11 – Test No. 25: Electrical fast transient/burst test** This section references "IEC 61000 PT 4" (IEC 61000-4-4, Electromagnetic compatibility (EMC) Part 4-4: Testing and measurement techniques – Electrical fast transient/ burst immunity test)

    Exception: Product is required to pass the electrical fast transient (EFT) burst test at a level of 8 kV direct connected on mains for the voltage and current circuits; 4 kV capacitively coupled on I/O circuits.

    o **Section 4.7.3.14 – Test No. 28: Effect of electrostatic discharge.** This section references IEC 61000 Part 4-2, Testing and measurement techniques – Electrostatic discharge immunity test

    Clarification: Product will be tested with both positive and negative polarity impulses.

    o **Section 4.7.3.17 – Test No. 31: Effect of relative humidity**

    Clarification: Product will be tested for 24 hours at 85°C and 95% ±4% relative humidity.

- **ANSI C12.20, American National Standard for Electricity Meters 0.2 and 0.5 Accuracy Classes**

    All references are to the latest published editions.

160170-OPC-POD-12-16

SOUTHERN COMPANY ACCEPTANCE TEST STANDARD FOR NEW METERS

Inspection Level	AQL	*Electro-Mechanical* Limit	*Solid State- Transformer Rated* Limit	*Solid State- Self Contained* Limit
II	0.25	+/- 0.5 Full Load	+/- 0.2 Full Load	+/- 0.2 Full Load
		+/- 0.5 Light Load	+/- 0.2 Light Load	+/- 0.2 Light Load
4 Sigma		+/- 1.0 Power Factor	+/- 0.3 Power Factor	+/- 0.3 Power Factor

APPLICATION NOTES:

1. No outliers allowed for new meters. Outliers are OK for in service meter testing (ie damaged meters).
2. If OPCO determines that a second sample is warranted, then the second sample should be double the size of the first sample.
3. If the second sample fails, the OPCO may chose one of the following options.
   3.1 OPTION 1: send shipment back to vendor
   3.2 OPTION 2: calibrate 100% of shipment and charge vendor for having to calibrate the meters.
4. All references
   4.1 ANSI Z1.9 - 2003 version
   4.2 Sampling Procedures and Tables for inspection by Variables
   4.3 Double Specification Limit Variability Unknown

Attachment III

SOCO ASCII FILE FORMAT
FOR MANUFACTURER'S METER TEST DATA

Field Name Data	Type	# Bytes	Comments
User Company Number	AN	8	Right justified, zero fill left spaces Numbers provided by or SOCO
Manufacturer's Serial Number	N	10	Right justified, zero fill left spaces
Tester ID	AN	4	Value=MANF
Test Date	N	6	MMDDYY
Stop Test Time	N	6	HHMMSS
Meter Code	AN	6	Value provided by SOCO
Number of Dials	N	1	Value= 4 or 5
Year Next Test	AN	2	Value provided by SOCO
Type Test	A	1	Value= A
Full Load Test Results	N	4	Test results to nearest 0.1%, with no decimal. Right justified, zero fill left spaces.
Power Factor Test Results	N	4	Test results to nearest 0.1%, with no decimal. Right justified, zero fill left spaces.
Light Load Test Results	N	4	Test results to nearest 0.1%, with no decimal. Right justified, zero fill left spaces.
SOCO Flag	N	1	Value provided by SOCO
LAN Address 1	AN	10	Right justified, zero fill left spaces.
LAN Address 2	AN	10	Right justified, zero fill left spaces.
LAN Address 3	AN	10	Right justified, zero fill left spaces.
Functionality (Register)Code	AN	6	Value provided by SOCO
Demand Test Results	N	4	Test results to nearest 0.1%, with no decimal. Right justified, zero fill left spaces.
Demand Interval Length	N	4	Minutes/Seconds (MMSS)
Test Quantity	A	1	Equal A unless otherwise noted
Warranty Period	N	2	Warranty in months from date of purchase

TOTAL = 84 bytes

Manufacturer=   Quantity=
Meter Type=   First #=
Form Number=   Last #=
Date=   Meter Code=
                                 AEP Code=