OpenStrom - Sensor Considerations

One of the main open question for building the prototype is around which sensor ICs to use. This document should provide an overview of the different options, their advantages/tradeoffs and the final choice for building the prototype.

Options considered:

Part	Notes	Price (@1000)
ADE7753ARSZRL		10*2.35 (1 circuits) = $23.50
CS5484		5*$2.09 (2 circuits) = $10.45
78M6618	Supports only 8 circuits	1*$5.03 (8 circuits) = $5.03
STPM34TR		5*$1.50 (2 circuits) = $7.50
ATM90E26		10*$0.61 (1 circuit) = $6.10
10xACS758ECB-200B-PFF-T 10xACS712ELCTR-20A-T 3xPC817X3NSZ0F		Total (10 circuit?) = $9.91
ADE7757ARNZ		10*$1.70 (1 circuit) = $11.70
MPC 3909		10x$1.46 (1 circuit)= $14.60

Based on cost we should use either the STPM34TR, 78M6618 or ATM90E26, however we also need to ensure to all sensors support our requirements and that there are no other expensive components required to use a specific sensor that would significantly increase the BOM cost.

Questions:

- Are all chips supporting the measurement of electric power (P), reactive power (Q), apparent power (S), electric current (I), voltage (V), power factor (cos phi)
- Are some chips measuring additional data? Which ones?
- What is the maximum sampling frequency for each chip?
- How much current/voltage/load does the chip support? (minimum 20A / 240V / 4800W)
- What other components are required to use the sensor? Plus cost for other components (Only put the total cost of the components in this table. Add the components as footnote).

- Is there anything else good/bad about the sensor? (add in footnote)

	All Data	Additional Data	Sampling frequency (SF) Disaggregation rate (DR)	Maximum I / V / W	Other Components
ADE7753ARSZRL	yes	Zero Crossing generation output	SF: 27.9 kHz DR: 12.7 kHz	> 100A > 300V > 30kW Note 4	Note 5
CS5484	yes	Zero Crossing generation output.	SF ~3.9Khz; DR ~3.9Khz	> 100A > 300V > 30kW Note 4	Note 5
78M6618	yes	Zero Crossing generation output Dedicated CPU I80515;	1.ADC Frequency 5-6Mhz; 2. DT - 200Hz	471.5V Note 3 44.2 A 18.453kW	Note 5
STPM34TR	yes	Zero Crossing generation output	SF ~7.8 Khz; DT ~7.8Khz	> 100A > 300V > 30kW Note 4	Note 5
ATM90E26	no?	Zero Crossing generation output	1.SF - no info 2. SPI timing - very slow ~7-8Hz	65,535 A Note1,2 655,35V 32.767 kW	Note 5

MPC 3909	yes	Zero Crossing generation output	SR 14KHz DR 14KHz	> 100A > 300V; > 30kW; Note 4	
10xACS758 ECB-200B-P FF-T 10xACS712 ELCTR-30A-T 3xPC817X3 NSZ0F	primary current only primary current only optocou pler		Note 6 Note 6	200A 30A	no extra components no extra components
ADE7757AR N	yes	Zero Crossing generation output	1.SF 27.9 KHz	> 100A > 300V > 30kW Note 4	

Selection

Based on the technical parameters and the price point of the different options we have decided to use the STMicroelectronics STPM34TR

There are some additional technical notes relevant for the table above

1	All registers are of 16 bits. For cases when the current and active/reactive/apparent power goes beyond the above range, it is suggested to be handled by microcontroller (MCU) in application. For example, register value can be calibrated to 1/2 of the actual value during calibration, then multiply 2 in application. Note that if the actual current is twice of that of the M90E26, the actual active/reactive/ apparent power is also twice of that of the M90E26.
2	The accuracy is not guaranteed when the current is lower than 15mA.

3	Calculation of sensor parameters for 78M6618 IMAX = Imax (pk) / sqrt(2) = Imax (rms) Max ADC input = 250 mV = IMax (pk) * R shunt Example: With a 6 m* current shunt, IMax (pk) = 41.7 A => IMAX = Base_Imax (29.5 Amps.) VMAX Calculation: VMAX = Vmax (pk) / sqrt(2) = Vmax (rms) Max ADC input = 250 mV = Vmax (pk) * Shunt R / (Series R - Shunt R) Example: With a Series R of 2 MΩ and a Shunt R of 750 Ω, VMax (pk) = 666.42 Volts.
4	Calculation of Imax, Umax for Energy meter IC - Imax=Uinmax/Rburden)*Ratio<2deg16; Umax=Uinmax/(Rd1+Rd2)*Rd2 <2deg24; where: Umax - full scale value of input current ; Ratio Is/Ip for current transformer; Rd1,Rd2 - divider resistors;
5	Additional components - current transformer CT, shunts, voltage dividers resistors The overall cost is up to $1.4
6	These current measuring IC's should be connected to the high frequency sampling microcontroller ADC, such a pic32mx ones which has conversion time up to ~100ns If pic32mx is implemented which have MCLK -80Mhz and MIPS - 105, the energy parameters such a power, reactive, apparent power,power factor have to be computed by the resources of the pic32 micros.