Daniel Westerheim - FuelCellsEtc.com

Knowing what's happening inside a fuel cell is a critical function, especially as fuel cells are continuing to be developed. One important aspect of this is to measure the voltage of each cell in a stack. Although this may sound trivial, it can be more complex and more expensive than it may at first appear due to high voltages, high channel counts, communication types, etc. There are a few products commercially available that are designed specifically for fuel cell voltage monitoring.

Table 1 lists some of the Cell Voltage Monitors (CVMs) currently available – there may be a few others available but these represent the most common. One feature that sets CVMs apart from other, more mainstream data acquisition systems is the fact that the signal side is completely isolated and electrically floating relative to the communication and power supply portion of the electronics. This allows high voltage stacks to be measured and the capability of cascading multiple CVMs together to measure the large numbers of cells in high voltage stacks. All of the units listed have this capability.

	Lynntech	EuroTech (SMART Fuel Cell)				FuelCon			Yokogawa	
	CVM 2582A	CVM Pro60	CVM Pro90	Basic S/W	Graphic S/W	TrueData-CVM 10	TrueData-CVM 50	TrueData-CVM 70	DX2040	DX2048
Price	$3,200.00	$ 7,000.00	$ 8,200.00	$ 1,100.00	$ 3,200.00	$ 3,225.00		$ 10,275.00	$ 7,250.00	$ 7,930.00
Channels	32	60	90			10	50	70	40	48
Additional IO	2 K-type TC inputs (12-bit) 14 (10-bit) Analog Inputs (Optional) 16 Digital IO (Optional)									
Cascading	Yes (CAN: 16 boards - 512 channels; USB virtual unlimited)	Yes (up to 2790 channels)				n/a	up to 10 devices (500 Channels)	up to 10 devices (500 Channels)		
Cell Connectors	IDC						2 x Sub-D 25 pin	2 x Sub-D 25 pin		
Interface	USB, CAN, RS232, RS485	(2) independent CAN buses (1 data, 1 control)				Ethernet, CAN, RS232			USB, RS232, RS422A/485	
Alarms	Status LED	Contact Breaks; Masking of Individual Cells; alarming at violations of thresholds				Status-LED; Error Beep				
Webserver						Optional				
Data Memory	microSD					Compact Flash			80MB	
Voltage Range	+/- 2.0V or 0 to 4.096V	+/- 1.2V or +/- 2.8V				-2.5 VDC to +2.5 VDC				
Resolution	16 bit	12 bit				12 bit				
Voltage Accuracy	+/- 63 uV	0.10%				+/- 1 mV				
Sample Time	<0.25 ms/channel (<8 ms / 32 channels)	1 ms /channel (cycle time 80ms or 110ms)				< 2 ms / channel				
Electrical Separation	32 Isolated Channels					All Channels isolated				
Isolation Voltage	1 kV	1 kV				1 kV				
Common Mode Rejection	85 VDC					80 VDC				
Operation Temperature	0 C to 50 C	-25 C to +85 C				0 C to 35 C			0 C to 50 C	
Dimensions	121 x 104 x 32 mm (4.7" x 4.1" x 1.2")					210 x 165 x 85 mm (8.27" x 6.50" x 3.35"			288 x 288 x 221.6 mm	
Weight	0.25 kg (0.55 lb)					1.8 kg (3.97 lbs)			7.3 kg (16.1 lb)	
Enclosure		IP 54				IP 54				
Power Consumption	<2.5 W (500 mA)					35 W				
Power Supply	USB or External +8 to +30 VDC	7 to 60 VDC				24 VDC (Powersupply Optional)			24 VDC	

Another important feature in a CVM system is high speed acquisition. Again, this is especially important in systems with high cell counts since most CVM systems measure each channel in sequence and the larger the stack the longer it takes to measure all the cells. The newly released CVM designed by Lynntech and offered by FuelCellsEtc.com is especially remarkable in acquisition rate, with a rate of up to 5 kHz (4x faster than other systems) – a rate that is maintained regardless of how many CVM modules are linked together. This allows the researcher to closely analyze any voltage anomalies during load transients, regardless of the number of cells being monitored.

The third important aspect in measuring fuel cell voltages is accuracy. Accuracy, in conjunction with speed, allow the control system (or the researcher) to better diagnose what is happening inside the fuel cell. Voltage characteristics of the cells can provide information about the humidification of each cell, the health of the catalyst, which cells may be exhibiting crossover, and a myrid of other information important to the operation of the fuel cell. There are a number of ways to ensure accurate voltage measurements. Accuracy begins with noise reduction and equipment selection. The CVM should be placed as close to the fuel cell being tested as possible, minimizing the cable length between the CVM and the fuel cell. This will reduce the amount of noise picked up by the cables and transmitted to the CVM. In addition, the CVM must be selected to provide as much accuracy as possible – It is far easier to filter and smooth a high accuracy signal than it is to try to obtain additional accuracy later.

These are the primary drivers of CVM selection, although many other factors may come into play: available communication standards, removable storage options, size, power consumption, etc. Overall, the total cost to implement the solution must be considered. Even if the unit cost may be slightly less for one unit, be aware of what other necessary components would cost, such as cabling, software, LabView drivers, etc. The Lynntech Cell Voltage Monitor includes all software and LabView drivers in the initial price while the cable is designed for a simple, low-cost IDC style connector and ribbon cable (similar to a hard-drive cable), resulting in an overall lowest cost solution even while providing superior performance characteristics than other solutions.

Daniel Westerheim is Manager of FuelCellsEtc.com; a supplier of custom fuel cell components supplier including Lynntech MEAs and Cell Voltage Monitor. Visit their webpage at www.FuelCellsEtc.com for a list of other products and services or purchase at FuelCellsEtc.com\Store . Mr. Westerheim can be reached for any further questions at dwesterheim@FuelCellsEtc.com