

# PMBus and SL Power Products





## POWER SUPPLIES EQUIPPED WITH I<sup>2</sup>C COMMUNICATIONS

There is slow evolution in power supply technology compared to some other Integrated Chip (IC) based technology. Last several years it has seen that the requirements of power supply have started to get challenging with need for high efficiency, high power density, flexibility and ease of integration and control. To achieve some of these requirement Power Management Bus (PMBus) was added to traditional power supply. For years PMBus, CAN Bus, RS-232 and others SPI's have been used to relay basic serial messages between devices. PMBus is based on the I<sup>2</sup>C interface protocol and is designed for controlling and monitoring power supplies. More recently, digital control via ethernet and USB communications have provided engineers/technicians with the ability to remotely monitor these devices. Front end power supplies with a web-based interface for remote monitoring is very attractive and provides a variety of benefits to users. Using I<sup>2</sup>C chips, an I<sup>2</sup>C master controller, and a digital interface, power supplies are one of the devices that can be remotely monitored and controlled.

Primary benefits of power supplies with I<sup>2</sup>C bus communications:

- Easily monitor output voltage, output current, output power and operating temperature.
- Reduced labor costs associated with monitoring power consumption.
- Can remotely turn on/off outputs as needed hence saving energy.
- Can be integrated to web based interface for modern communication system.
- Easier and faster troubleshooting when matrix of power supplier is used, e.g. Vertical farming.
- No or less increase in cost of power supply units.

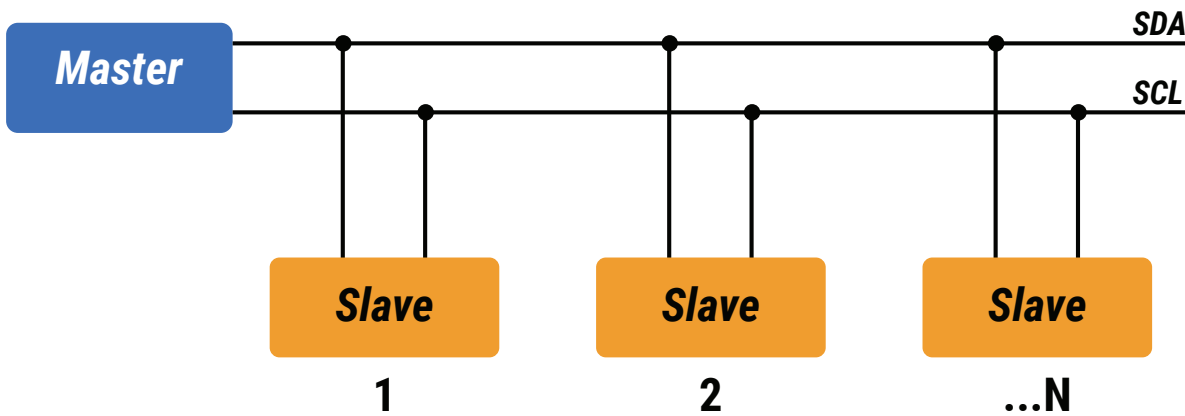
Remotely monitoring the output voltage ( $V_{out}$ ), output current ( $I_{out}$ ), output power ( $P_{out}$ ), and operating temperatures of power supply allows for timely solutions to be applied in case of a failure. The addition of I<sup>2</sup>C interface as an option to a power supply unit makes it easier to integrate a power supply to digital web-based interface communication systems making these power supply highly advantageous in today's connected world. The whole system can be controlled as a cluster of power supplies working independently where various outputs can be remotely turned off or on as needed. Industries can reduce labor costs by monitoring many power supplies (and other connected devices) from one central location instead of in-room monitoring of power consumption.

Using a web interface makes power management from anywhere in the world a feasible option. Power supplies equipped with I<sup>2</sup>C and Ethernet communications are the ideal solution for green houses/vertical farms and where an integrated lighting solution is needed. Examples are: Entertainment and sporting events, data centers, or any system where remote monitoring is preferred or necessary.



## HISTORY, BACKGROUND AND BASIC THEORY OF OPERATION

Philips developed I<sup>2</sup>C to solve the problem of connecting multiple devices each with address and data lines through a low bandwidth short distance protocol using two wires serial data (SDA) and serial clock (SCL) and a common signal return. In a typical I<sup>2</sup>C bus connection there are two active wires SDA and SCL and extra ground connection which is not shown in Figure 1. Both SDA and SCL are bi-directional connection lines. All the communication takes place on only two wires so all the device must have unique address.

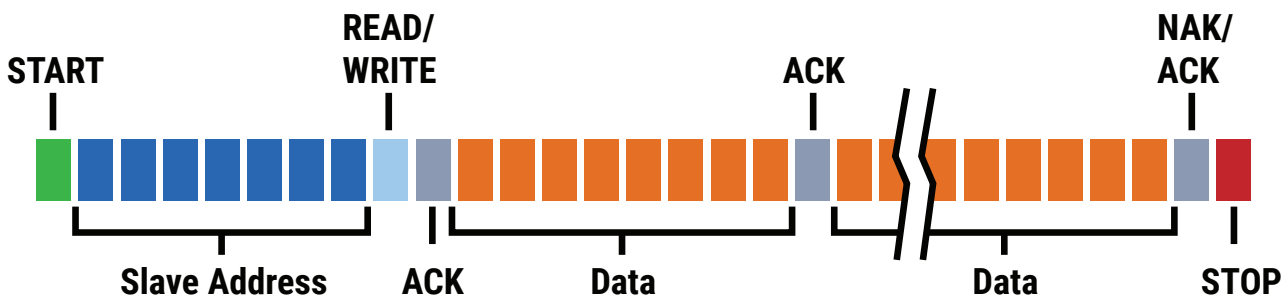


**Figure 1:** Sample block diagram showing N number of slave connected to master device through common bus in I<sup>2</sup>C Implementation

Here is a simplified description of the I<sup>2</sup>C has a master/slave protocol.

- The master initiates the communication by issuing a start condition. This condition informs all the slave devices to listen on the serial data line for their respective address.
- The master device sends the address of the target slave device and a read/write flag.
- The slave device with the matching address responds with an acknowledgment signal.
- Communication proceeds between the master and the slave on the data bus. Both the master and slave can receive or transmit data depending on whether the communication is a read or write. The transmitter sends 8 bits of data to the receiver, which replies with a 1 bit acknowledgment.
- When the communication is complete, the master issues a stop condition indicating that everything is done.

Originally I<sup>2</sup>C bus was developed as a multi-master bus allowing more than one device to initiate transfers in an active system. When using only one master on the bus there is no real risk of corrupted data, except if a slave device is malfunctioning or if there is a fault condition involving the SDA/SCL bus lines. In I<sup>2</sup>C protocol device that initiate the communication is the master and all the other device connected to the bus in considered slaves.



**Figure 2:** Sample data stream of the I<sup>2</sup>C protocol



I<sup>2</sup>C bus only uses two wires hence in figure 2 this protocol includes the extra overhead of the addressing and acknowledgement mechanisms. I<sup>2</sup>C has simple bus communication protocol and simple hardware requirement with standard connection of three wire. But it still has all the functionality that is required for communication and easy to integrate power supply for diverse application. Philips I<sup>2</sup>C specification for detailed information. Current version of I<sup>2</sup>C specification is Ver 2.1 - 2000.

## PMBUS POWER SUPPLY UNIT (PSU) FOR SMART HORTICULTURE LED LIGHTING SYSTEMS

Growing leafy greens, cannabis, vine crops or flowers using greenhouse, grow rooms/plant factories, vertical farming, hydroponic/aquaponics grow facilities and grow containers and modules will benefit from using smart LED lighting system. Leading university and research centers have been developing light spectrums to deliver the light wavelength that the plants need for higher yields, healthier plants and shorter grow cycles. Smart LEDs products for horticultural deliver long life, consistent spectral color output and Parabolic Aluminized Reflector (PAR) values that meet the growing recipes for different plant types. Smart LED lighting fixture can be easily designed using smart communicable PSU with a PMBus communication channel. This can include various functionality suitable for real time information capture, efficiency and power management functions. Smart cloud-based LED fixtures that enables predefined schedules, Standard Operating Procedure (SOP) instructions, product mix and many variables necessary to manage multiple grows and/or products (crops). These local and virtual applications monitor, and control single or multi- site grow facilities. Web based dashboard reporting can be monitored on-line or trigger text, email or voice alerts if deviations are detected. Power supply data can be logged for historical comparison, allowing for trended profiles to optimize your work flows and gain consistent quality and predictable yields. SL power can provide solutions with I<sup>2</sup>C based communicable power supplies that will help LED fixture manufacture to enable them to build smart LED system. These power supplies will enable fixture manufactures reduce design time and cost.

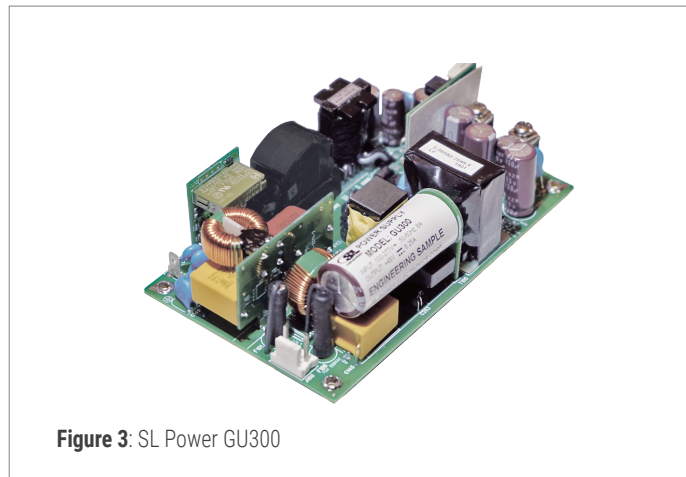
SL Power is a leader in providing solution suitable of LED fixture manufactures in entertainment and AV market.

### GU300

The SL Power Electronics GU300 family is a superior performance 300 Watt AC to DC power supply designed to ensure easy integration into medical & industrial applications. It has a universal AC input range of 85 to 264 VAC over a wide temperature range of -20°C to +70°C. Highly efficient, the GU300 family comes in both Class I and Class II input versions for added flexibility in regulatory compliance. The auxiliary output is always on while AC power is available while the main output can be inhibited to reduce power consumption during non-use applications.

The “PMBus® functionality” enables easy remote monitoring and control of the power supply to respond to particular operating conditions or to protect system operators. GU300 power supplies are designed to meet Class B Radiated & Conducted EMI specifications with margin and come with a 3-year warranty.

For more information on GU300 please contact SL Power.





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