DMI MICROGRID LINK

DMI1702

MicrogridLink Communication and Control Processor

DESCRIPTION

DMI's MicrogridLink communication processor (µGridLink) is a stand-alone, general purpose communication and control processor. It serves as the control for a battery bank, string of PV panels with boost controllers, rectifiers, generators or inverters. Each µGridLink is programmed with a "personality module" for the device it controls and monitors.

The µGridLink card has multiple forms of communication: Bluetooth BLE communications is used with the DMI Android/IOS app. The API for the communication protocol is available for use with other apps or monitoring systems.

Depending on the application and the installed personality module, the µGridLink communicates and controls devices via UART, MODbus (RS485/RJ11), and isoSPI (RJ45). The personality module supports individual device characteristics such as the maintenance schedule of a generator, or the type and capacity of batteries.

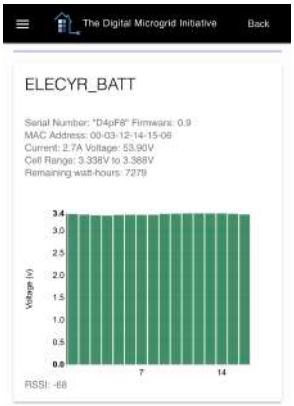
The µGridLink maintains history of the controlled devices. This information is typically uploaded to a cloud-based server when the µGridLink connects via Bluetooth to an app or control processor.

FEATURES

- ATSAM3S 32bit micro processor
- Powered by either 110V AC/380V DC or up 12V to 80V DC
- ATSAMB11 Bluetooth 4.0 processor module
- On board calendar clock with 30 year backup
- Back up battery up to two weeks
- High speed isoSPI™ communication
- UART (3.3V)
- Support of off-board LEM current transducers
- 2 GPIOs and 2 digital outputs for MOSFET control
- Bluetooth Low Energy (BLE) communication with app or central controller
- Multi-color LED for on-off and status reporting
- RS-485 MODbus master and optional CANbus support

APPLICATIONS

BATTERY MANAGEMENT: When used for battery management control, the µGridLink supports five DMI Open Source Battery Manager cards via an isoSPI™ port. It maintains the history for all the cells (high and low voltage hourly), determines the state of charge of the battery and reports any weak cells.



The µGridLink maintains a history of the bank over several months. This is particularly important to determine balancing characteristics and state of charge for dynamic applications which have continuous charge/discharge and are always in a partial state of charge.

For lithium batteries, the high and low inflection points are recorded to rank the quality of cells and determine weak cells that may be affecting battery capacity. For lead-acid batteries with relatively slow response time and a more gradual discharge voltage, history over a half hour or more is used to assist determination of the charge state in dynamic charge/discharge applications.

The µGridLink card controls two optional, external high power FETs which can turn off all charge and/or discharge power to the bank; and an external current monitor (LEM) which measures current to or from the battery bank or other device.

When used with the DMI1703/1704 DC-DC Converter, the µGridLink acts as a master for both converter and battery

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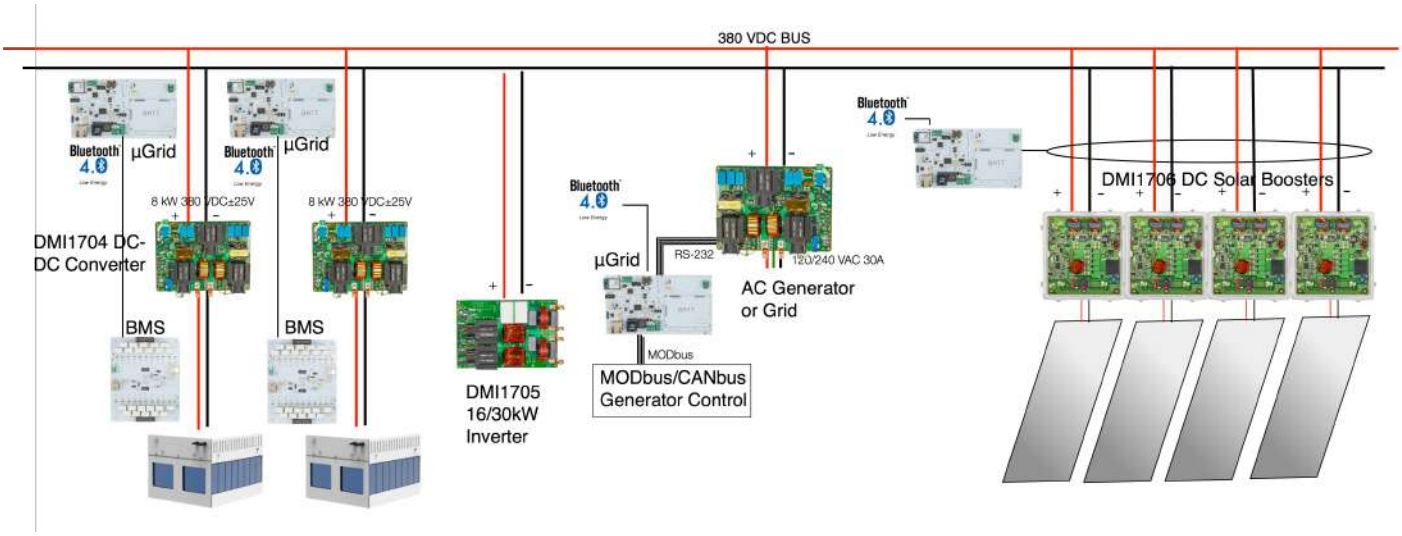

management. The µGridLink configures the BMS cards first and sends a request for battery voltages. Then, it makes a decision based on the health of the battery to allow charging or discharge of the battery.

The µGridLink has two states for the pack of cells, "allow-charge" and "allow-discharge". Allow-charge is defined as having each and every cell in the pack be at or below a maximum cell voltage (3.67v for LFP). Allow-discharge is defined as each and every cell being above a minimum voltage (nominally set to 3.0v). Both of the settings are settable by remote command. The state of having both allow-charge and allow-discharge be off is a fault condition for the pack and requires service to the pack. The usual operating condition will be for both allow-charge and allow-discharge to be on or one or the other to be on.

GENERATOR CONTROL: When used with the a generator, the µGridLink can operate as a reflex agent providing functions such as autostart, time-of-day restrictions, etc. As a utility-agent, the generator control µGridLink communicates with clients needing power by advertising a price determined by such factors as cost of fuel, efficiency curves at various output levels, maintenance history, etc. It does this in aggregate with multiple clients so that as more power is needed by multiple clients, generators which operate more efficiently at high power output will gain a pricing advantage. When little power is required, smaller generators will have an advantage.

SOLAR MEASUREMENT AND CONTROL: The PV panel array provides power to the bus at a voltage determined by the array but within a limited range. The panels will not be able to provide charging to the batteries unless the voltage to the bus is greater than a preset level. The DMI µGridLink associated with a PV string will maintain a history of each panel output with a granularity of no more than one hour.

GRID POWER UTILIZATION: The µGridLink can provide control for rectifiers and for bidirectional (grid-tied) inverters. Unlike traditional grid-tie inverters, decisions to provide power to the grid or take power are based on local decisions and negotiation and cost of power as well as such factors as time-of-use metering.

INVERTER CONTROL: When used with an inverter, the µGridLink monitors power consumption and can provide demand response by selectively shutting down inverters.

MICROGRID BRIDGING: The DMI Microgrid Bridge (available in early 2018) is a bi-directional DC-DC converter between two 380 volt microgrids. It will have provision to accept commands to move power between microgrids at a programmed current. Intelligent agent policy and negotiation will determine how much energy will move between microgrids and the optimal routing of power in a hybrid AC-DC network with possible redundant DC topology.

RAPID SHUTDOWN: For rapid shutdown in an emergency, it's required to be able to completely shut down the DC bus. This requires shutdown, from a single point switch, of each power contributor within 2 to 3 seconds.

An optional "heartbieat" controller provides either a low power control circuit or radio signal which must be live for the operation of each of the modules.

DMI has designed its module packaging for mounting on a single "rail" which provides a low voltage keep-alive signal. with a very low voltage control line built into the mounting.

GROUND-FAULT DETECTION: The 380 vdc two-wire (+190, -190) busses are designed to conform to commercial and USCG safety requirements and all cabling is armored and ground-fault protected. The bus may be either ungrounded or mid-point grounded. Single-wire, earth-grounded power may also be accommodated in land-based applications. The µGridLink can interface to an ABB CM-IWN.1 for very precise ground fault detection and shutdown.

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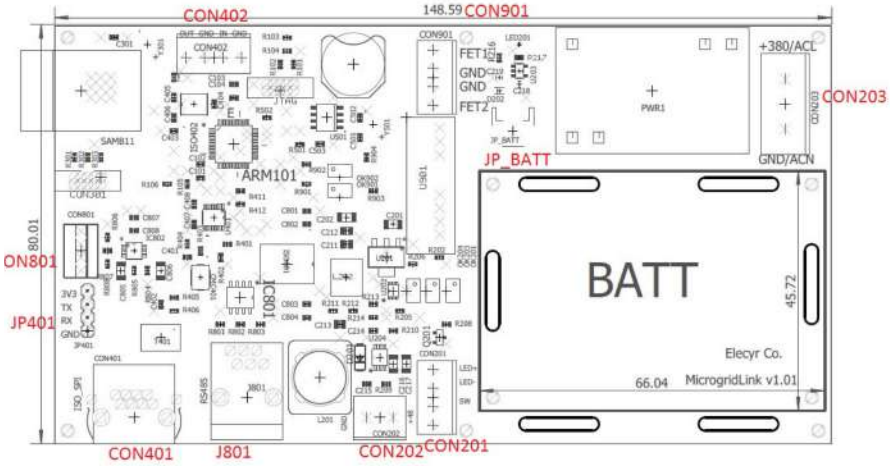
OPERATION

JP_BATT: back up lithium polymer battery
CON201: Switch button and switch LED
CON202: Battery in (12V to 80V)
CON203: AC in (85 - 305VAC; 120 – 430VDC)
CON401: isoSPI (RJ45)
CON402: GPIOs and ground
JP401: UART (5V max)
CON801: LEM
J801: RS485 (RJ11)
CON901: FETs Control (5V GPOs)



POWER: The µGridLink can be powered by monitored battery, a back-up battery or power outlet. An on-board, non-isolated step-down converter to 5V and 3V to power the processors and other peripherals. AC power (CON203) can be directly connect to power outlet (110 - 230VAC) or a high voltage DC bus with range voltage range(120V-430V). It utilizes the Mean Well IRM-03-12 step the voltage down to 12V and feed it in on-board 5V converter. Back-up battery can be any battery with JST-2 style connector. Typically, a 500mAh lipo battery which can power the board approximately 2 weeks depends on the usage. There is an on-board battery charger to charge the back-up battery when there is other power source connected. Also, the microprocessor monitors the voltage level of the back-up battery via ADC. A 12mm coin battery dedicates to power the on board real time timer which can last up to 30 years .

UART: The UART is driven by the ATSAM3S at 3.3V. There is no voltage protection for it, so it requires installer to ensure the power level of other device is also at 3.3V as well as they can share same ground. This connection mainly reserved for communication with DC-DC converter and other DMI devices.

IsoSPI™: Linear Technology's isoSPI protocol is a two-wire isolated communication protocol. See LTC6820 data sheet for detail of operation. This protocol is used to communicate with the Battery Manager Board (LTC6811)

RS485: The µGridLink can be configured as a master in RS485 protocol via J801. It provides 5V power and sharing ground with slaves on the line. This is disabled when ugrid link only powered by back up battery.

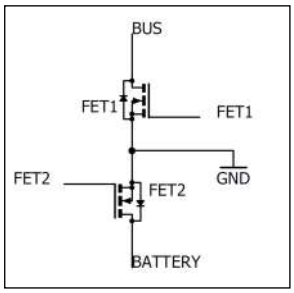
CURRENT MEASUREMENT: CON801 is a special connector for connecting LEM HASS series of current transducers. It provides 5V power. LEM HASS current transducers are capable of measuring up to 600A with 1% error

GPIO: There are two 5V level GPIO ports (GPO, GPI) with 2 ground. Both can be configured as either input or output.

Switch's LED pins (CON201) are two outputs directly out of the microprocessor atsam3s at 3.3V level.

SWITCHES: CON201 is for connecting either momentary or pushbutton switch. The maximum voltage rating of the switch needs to be higher than the battery voltage which is between 12V to 100V. Changing different style of switches requires firmware modification to work properly. There are also two pins for supporting the LED of the switch if applicable.

FET CONTROL: CON901 has two outputs and ground ports for controlling MOSFETs in the case with no battery charger control. The voltage level of the output depends on the isolated power supply installed at U901. Typical application for 48V using PH02S4815A power supply with MOSFET IXTN550N055T2 for controlling 40A input or output. Note that PH02S4815A is an isolated 5V power supply. Therefore, the GND ports of CON901 are isolated from the ground of the board. Connection of FETx and MOSFET is showing as following



PROGRAMMIING: ATSAM3S requires setting up the real-time timer and the system configuration before first time use.

Before setting up the real-time timer, the 12mm coin battery needs to be installed. Then, open the real-time timer program to manually insert year, month, date, hour and minutes and run it. Once it is running successfully, stop it and run the battery manager program without real-time timer setup function.

For using Microgrid Link with BMBs, programmer needs to modify the configure parameters in main.h files before running the program. Parameters includes number of devices, number of cells, dissipation voltage level, and voltage levels of charge control etc.

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