

# Replacing/Mixing an FM100 into an existing System with an FM60/80

## Objective of the application note

This application note will provide information on the integration of the FLEXmax 100 (FM100-300VDC) with other FLEXmax products (FM60-150VDC or FM80-150VDC) and PNL-GFDI products. This applies to systems where the GFDI is installed and/or required.

## Introduction

There is little benefit to mixing an FM100 with an FM60/80. If circumstances require it, this application note will explore an option.

The FM100 has an integrated PV ground-fault detection and a maximum PV system voltage rating of 300 Vdc, where the FM60/80 uses an external ground fault protection (both the FM60/80 and the PNL-GFDI-80, PNL-GFDI-80D and PNL-GFDI-80Q are rated for a maximum PV system voltage of 150 Vdc). Under certain conditions, a fault on one PV array can impact the fault detection circuit for other arrays on the same system. An overcurrent condition on one 80 Adc circuit could also cause the ganged breakers to trip. All devices must be rated for the highest maximum PV system voltage within that system. When mixing the FLEXmax models with the FM100 there are special considerations.

One must consider the benefits, complexity and cost of mixing models. Replacing the remaining FM80 with an FM100 may be the best option.

## Solution

This note will explore options when considering integrating mixed model charge controllers:

Option 1) Replace FM60/80 with FM100

Option 2) Size the FM100 below 150 Vdc to utilize the OutBack GFDI on battery side

### Option 1) Replace FM60/80 with FM100

Depending on the application, replacing the FM60/80 may be the most cost-effective solution. Consider the reduction of Balance of System (BOS) components needed, decreased system complexity, and installation time when making the decision.

### Advantages

1. Utilize BOS benefits of the FM100
2. Utilize the increased power benefits of the FM100
3. Utilize the Rapid Shutdown and communication advantages of the FM100
4. Utilize FM100 internal ground fault protection
5. Reduces complexity of system

## Application Note

### Disadvantages

1. Some additional cost

### Procedure

1. Purchase FM100 to replace the existing FM60/80
2. *Optional:* Add modules to the previous FM60/80 array
3. Read FLEXmax 100 manual for information on stacking multiple FM100 controllers
  - a. If modules are added or reconfigured to a higher voltage; replace PV circuit breakers to an appropriate voltage and current (PNL-100-300VDC)
    - i. Ensure conductors are also properly sized from this change.
  - b. Replace PNL-GFDI-80, PNL-GFDI-80D or PNL-GFDI-80Q with circuit breakers as the FM100 has internal Ground Fault Protection (PNL-125-300VDC)
    - i. Ensure the circuit breaker voltage rating is equal or higher than PV array voltage
    - ii. Ensure the circuit breaker amperage is appropriate (FM100 amperage output is 100 Adc to 125 Adc)
  - c. Remove the GFDI fuse on all FM100 controllers except one. This is described in the FLEXmax 100 manual.
  - d. If OutBack Rapid Shutdown is installed, other rework may be needed (see Rapid Shutdown section below)

Old Component		New Component	
Name	Example Part	Name	Example Part
CC Output Breaker GFDI	PNL-GFDI-80(D/Q)	CC Output 300 Vdc Breaker	PNL-125-300VDC
CC Input Breakers	PNL-80-DC	CC Input 300 Vdc Breaker	PNL-100-300VDC
		Remove GFDI Fuse in <b>All</b> but one FM100	
		Read Full Manual	

**Table 1: Summary of Components to Replace**

## Application Note

### Option 2) Size the FM100 below 150 Vdc to Utilize OutBack GFDI on Battery Side

The OutBack PNL-GFDI-80, PNL-GFDI-80D and PNL-GFDI-80Q have options to provide detection and protection for up to four charge controllers. This GFDI is rated for 150 Vdc. In order to mix the FM100 and FM80 and utilize the PNL-GFDI-80: All strings, including all new arrays, would need to be configured to not exceed 150 Vdc maximum PV system voltage and to not exceed 80 Adc output current.

**NOTE:** It may be necessary to replace the existing PNL-GFDI-80 for another with additional poles to disconnect the new controllers. At least one pole is needed per controller.

#### Advantages

1. Utilize the Rapid Shutdown and communication advantages of the FM100
2. Maximize utilization of existing components and configurations.

#### Disadvantages

1. FM100 is constrained by programming or design due to the PNL-GFDI-80 150 Vdc and 80 Adc rating
  - a. This effectively programs the FM100 to behave like an FM80
2. Does not utilize BOS benefits of the FM100
  - a. FM100 allows high number of modules in fewer strings; using with multiple strings of 150 Vdc or less may re-introduce additional hardware
3. Cannot have strings that exceed 150 Vdc maximum PV system voltage.

#### Procedure

1. Replace existing PNL-GFDI-80 with one that has at least one pole per charge controller.
2. Size PV strings to 150 Volts maximum PV system voltage ( $V_{oc}$  at coldest expected temperature).
3. Constrain FM100 to 80 Adc output:
  - a. Size array so that it may not exceed 80 Adc battery output, and/or
  - b. Program FM100 to 80 Adc maximum output in the **Charger Menu** on the MATE3s or AXS port.
4. Remove the bonding jumper to disable the FM100 internal ground fault detection when using the PNL-GFDI-80 external ground fault detection.
5. Connect the FM100 **BAT+** conductor to one pole of the PNL-GFDI-80. Connect each corresponding pole to the battery + bar as normal.

## Application Note

### Mixing FM100 with an FM80 Rapid Shutdown Solution

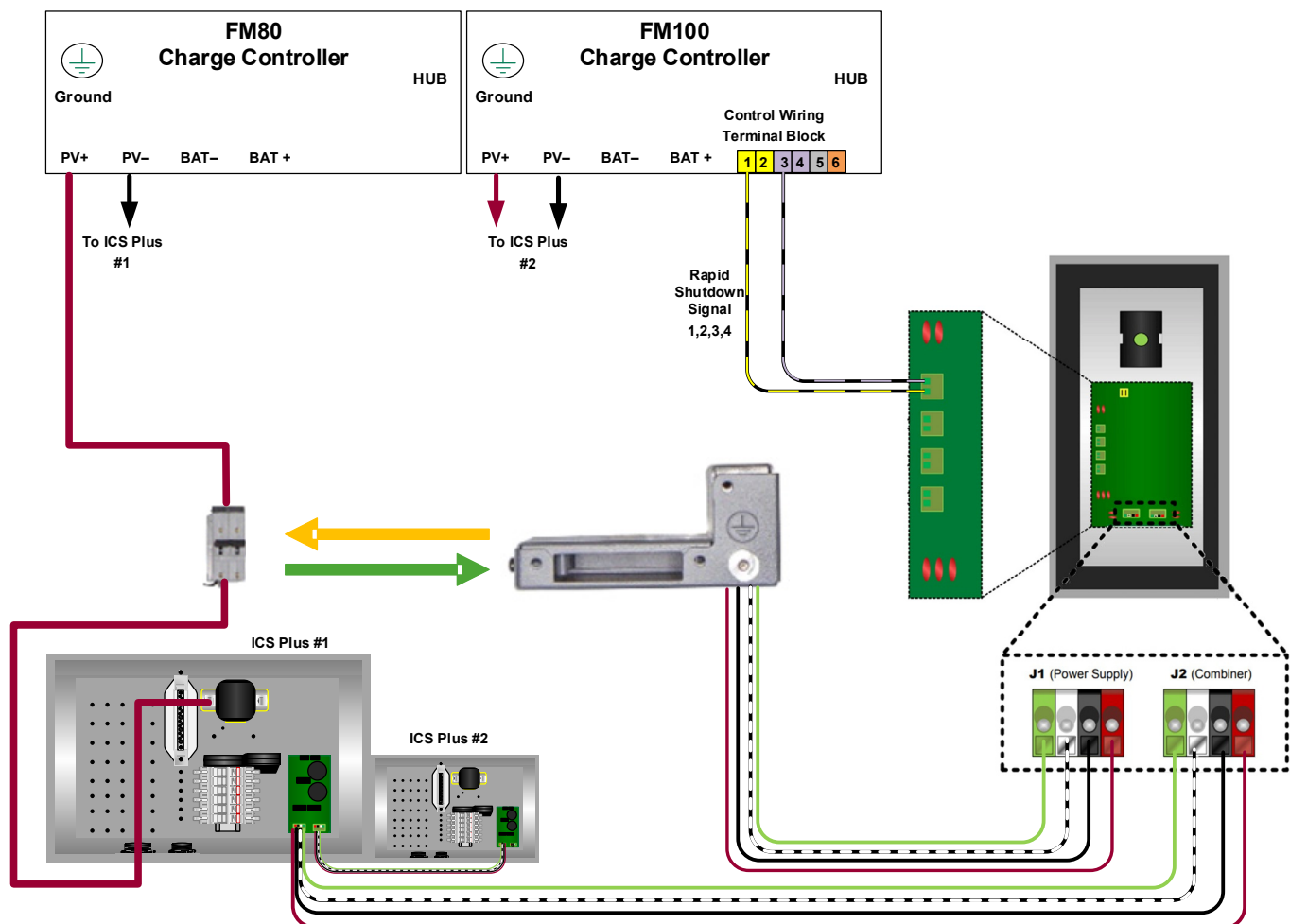
In response to a PV Rapid Shutdown initiation, the FM100 can attenuate its PV circuit connections to meet the NEC 690.12 requirements, while the FM60/80 require a remote trip circuit breaker to disconnect the PV circuit conductors. The following section outlines the installation considerations when combining the two controllers in a single system.

For a mixed FM100 and FM80 ICS Plus configuration, there are two main circuits; the control circuit and the PV circuit.

The control circuit utilizes the FM100 auxiliary terminal block to receive the Rapid Shutdown signal from the Rapid Shutdown Initiator (RSI). Connect FM100 terminal **1** and **3** with the RSI **J3** terminal.

The FM80 control circuit remains the same. It utilizes the RSI **J1** and **J2** terminal blocks, as indicated in the ICS PLUS manual, to have the breaker control and power supply (BRK-CTRL-DC) to control the remote trip breaker (RSI). (See Figure 1.)

**NOTE:** In this configuration, terminals **5** and **6** may not be used for Rapid Shutdown Confirmation into **J4**.

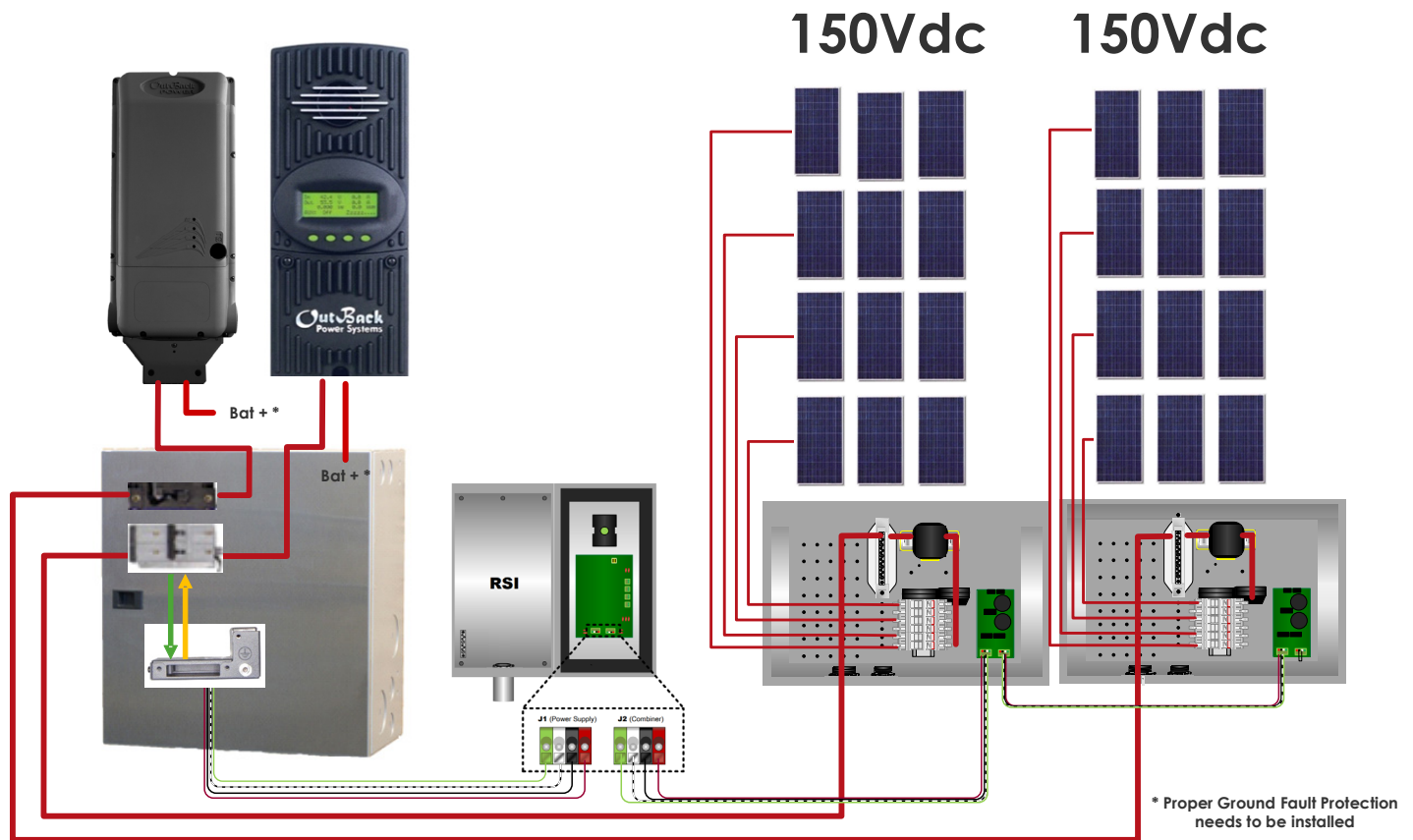


**Figure 1 FM100 and FM80 RSD Control Circuit**

## Application Note

The ability of the FM100 to attenuate its PV circuit connection thus the RTB, BKR-CTRL-DC are not needed, unlike the FM60/80.

The FM80 power circuit remains the same. (See Figure 2.) Up to 6 combiner boxes may be used for a single RSI/Power Supply.



**Figure 2 FM100 and FM80 PV Circuit Single Line**

## Exceptions or Precautions

Implement the solution in accordance with local laws and codes. Compliance is at the discretion of the local authority having jurisdiction (AHJ).

The ICS Plus system has a PV Rapid Shutdown Solution (PVRSS) listing. All components in a system are verified by a nationally recognized testing lab (NRTL) to work together and meet the PV rapid shutdown functionality.

Components individually with a PV Rapid Shutdown Equipment (PVRSE) listing are that component meet the specified functionality and can be used within a PV rapid shutdown system. Products listed to these standards can be used with one another to meet the intent of NEC 690.12. It is up to the installer and AHJ to verify that PVRSE items are compatible and meet Code requirements. The FM100 is listed as PVRSE.

## Application Note

### About OutBack Power Technologies

OutBack Power Technologies is a leader in advanced energy conversion technology. OutBack products include true sine wave inverter/chargers, maximum power point tracking charge controllers, and system communication components, as well as circuit breakers, batteries, accessories, and assembled systems.

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