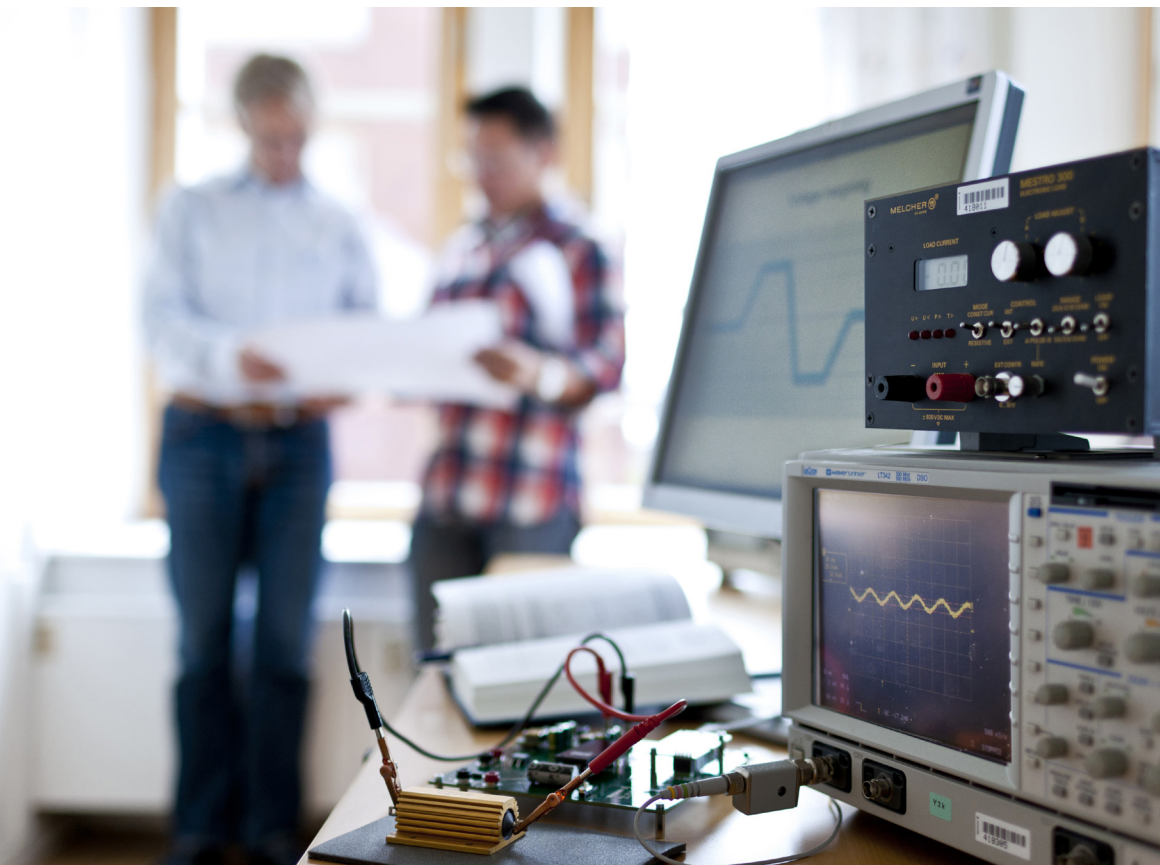


# On/Off Control Using the Remote Control (RC) pin on Flex Power Modules



## Abstract

Most DC/DC converters throughout the industry offer some type of remote control function to enable the converter to be turned on or off by means of an external control signal. While some degree of standardization exists between converter suppliers, the standardization is far from complete.

To make matters more confusing, there is often more than one option available for the control interface, and some suppliers use different terminology to describe the control interface. Issues such as control pin return referencing and input/output isolation also come into play.

This design note clarifies the above types of variables as they relate to Flex power modules. The differences between positive and negative logic are described and suggestions and solutions for designing the RC pin interface are provided. This information is provided for both isolated and non-isolated power modules currently in production.

## Introduction

The remote control (RC) pin allows the converter to be turned on or off by an external device such as a mechanical switch, a transistor, a logic gate or an optical isolator. The remote control pin in Flex power modules is always referenced to the negative input, which is common with output return in non-isolated converters. For isolated converters, the control signal is therefore referenced to the primary side return which is not common with the output return if isolation is to be maintained. Thus, the most convenient method of control for isolated converters is to have the control circuitry on the primary side of the isolation barrier.

If secondary referenced control is required, it can be achieved with an optical isolator as described later. Most of the examples shown in this design note will assume the utilization of a discrete primary side transistor for the control element, but the techniques can be readily extended to the other control elements mentioned above.

## Control Configurations

There is no complete standardization of control configurations within the DC/DC converter market. Many suppliers have, however, offered a choice of control signal polarity. This choice is most often selected by means of an option number on the converter, with one polarity designated as "standard" and the other as an option. Most series of Flex power modules offer such an option. The most common way of referring to this option of control signal polarity is "positive logic" or "negative logic".

Positive logic implies that the converter will be operating when the control signal is positive (high logic state) relative to its reference (always the negative input for Flex power modules). Negative logic implies that the converter will be operating when the control signal is at a low logic state relative to its reference. The implementation of this interface varies somewhat between isolated and non-isolated converters as described below.

For both isolated and non-isolated converters with positive logic, the converter operates normally if the RC pin is left open or connected to a high level. The converter is turned off by connecting the RC pin to a low level or to the negative input. The level definitions vary from product to product and will be defined later in this design note. The RC pin is referenced to the negative input.

For non-isolated converters with negative logic, the converter operates normally if the RC pin is left open or connected to a low level or to the negative input. The converter is turned off by connecting the RC pin to a high level. The level definitions vary from product to product and will be defined later in this design note. The RC pin is referenced to the negative input.

For isolated converters with negative logic, the converter operates normally if the RC pin is connected to a low level or to the negative input. The converter is turned off by connecting the RC pin to a high level or by leaving it open. Note that for this configuration a connection of some type must be made to the RC pin to allow operation of the converter. The level definitions vary from product to product and will be defined later in this design note. The RC pin is referenced to the negative input. The above RC pin control configurations are summarized in Table 1.

RC pin connection	Non-Isolated		Isolated	
	Negative Logic	Positive Logic	Negative Logic	Positive Logic
Open	converter ON	converter ON	converter OFF	converter ON
Low or input return	converter ON	converter OFF	converter ON	converter OFF
High	converter OFF	converter ON	converter OFF	converter ON

Note: High and low level ranges vary by product as defined in Table 2.

Table 1 - RC pin control configurations.

## RC Pin Interface

Flex power modules include an internal pull up or pull down resistor so that an open collector or open drain transistor can be used to drive the RC pin interface, as shown in Figures 1 and 2.

The critical parameters of the interface are the current sinking capability of the external transistor and the voltage at the RC pin when the transistor is in its on and off state. The minimum current sinking capability of the external transistor is specified in Table 2.

With the transistor in the on state, the RC pin voltage will be determined by the internal drop in the transistor at the stated sink current. With a low leakage transistor, the RC pin voltage when the transistor is in the off state will be the internal power module voltage to which the pull up resistor is tied. The limits for both the low and high level RC pin allowable voltage ranges are shown in Table 2.

Table 2 also provides the termination voltage for the pull up or pull down resistor internal to the power module. Table 2 is intended as a general comparison and summary of the control interface for Flex power module product families. Please consult the product technical specification for the most recent available information on the RC pin interface.

**In applications that do not require remote control of the converter, the RC pin may simply be left open in most situations.**

This will enable the converter to turn on as its input voltage is applied and function normally. The exception is for isolated converters with negative logic. As described previously, the RC pin for these converters should be tied to the negative input to allow operation without an external active device on the RC pin.

As indicated earlier, there are several possible devices that can be used to drive the RC pin interface on Flex power modules and even a greater variety of possible circuit implementations. The circuits shown here should provide a general knowledge of suitable interface techniques. They are depicted using mostly discrete transistors but may easily be extended to other types of devices.

Figure 1 shows typical interface circuits for use with non-isolated converters. Figure 1a depicts the positive logic implementation with a discrete transistor control element. A TTL logic gate could also be used, as depicted in Figure 1b.

Since the input and output of non-isolated converters have a common negative/ground connection, the control circuitry can be referenced to either the input or output of the converter. Figure 1c is the most commonly used circuit for driving a negative logic non-isolated converter. In this case, a PNP transistor is used to drive the RC pin to a high level to turn the converter off. The internal pull down resistor allows the converter to run with no external connection to the RC pin.

Figure 2 presents some general circuits for use with isolated power modules. Figure 2a depicts the interface for both positive and negative logic isolated converters. Note that for the negative logic option, the external transistor must be conducting (RC pin at a low level) in order for the converter to operate. The opposite is true for the positive logic option.

A TTL logic gate can also be used to drive this interface as was shown in Figure 1b. Isolated converters provide an isolation barrier between the primary and secondary sides. Since the RC pin is referenced to the negative input, the circuits shown have all been referenced to the primary side. This is the easiest implementation in most cases. If it is required to have a control circuit referenced to the secondary side of the converter, this can be implemented by means of an optical isolator as shown in Figure 2b.

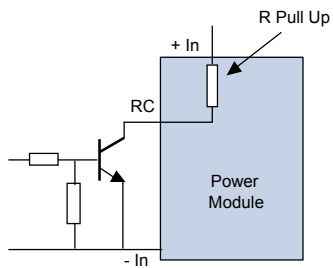
Product Family	Negative Logic	Positive Logic	Sink capacity (mA) (note 1)	Low level (V)	High level (V)	Internal resistor tied to (Note 2)
Non-Isolated converters						
PMC 4000	Optional	Standard	1	0 to 0.3	1.7 to 5.5	+In
PMC 8000	Optional	Standard	1	0 to 0.3	1.7 to 16	+In
PMB 4000	Standard	Optional	1	0 to 0.3	1.7 to 5.5	GND
PMB 8000	Optional	Standard	1	0 to 0.3	1.7 to 16	+In
POLA	Not available	Standard	1	< 0.8	Vin - 0.5	Vin - 0.5
Isolated converters						
PKM-E	Standard	Optional	1	0 to < 1.0	4 to 6, (max 18)	3.5 to 7.5
PKB	Standard	Optional	1	0 to < 1.0	12 to 15	12 to 15
PKJ-E	Standard	Optional	1	0 to < 1.0	4 to 6	3.5 to 6.0
PKM	Standard	Optional	1	0 to < 1.0	TTL or < 15	2.0 to 15
PKJ-B	Standard	Optional	1	0 to < 1.0	TTL or < 15	< 15
PKJ	Standard	Optional	1	0 to < 1.0	TTL or < 15	5.6
PKM-C	Standard	Optional	1	0 to < 1.0	TTL or 3.9 to 15	3.5 to 7.5
PKL	Standard	Optional	1	0 to < 1.0	TTL or 3.9 to 15	3.5 to 7.5

Table 2 - Comparison of control interfaces in Flex power modules.

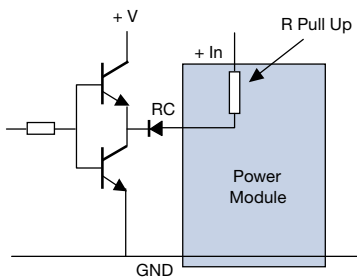
Notes:

- 1) Sink capacity is the current through the switch device connected to the RC-pin.
- 2) When the RC pin is open, it is internally connected through a resistor or a voltage divider to the specified voltage level.
- 3) Both means that the converter has either positive or negative logic that can be set by a selection pin. The logic can be programmed according to a table shown in the datasheet for this specific product.
- 4) Varies with input voltage.
- 5) Please consult Flex technical specification for more details.

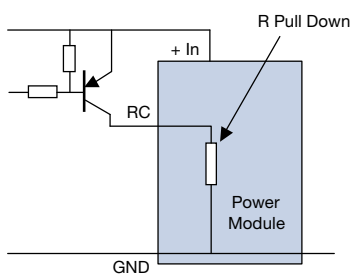
Figure 1 - Interface circuits for non-isolated converters.



a) Discrete Transistor

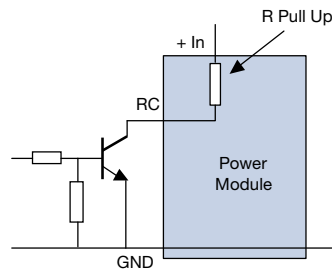


b) Positive Logic - TTL

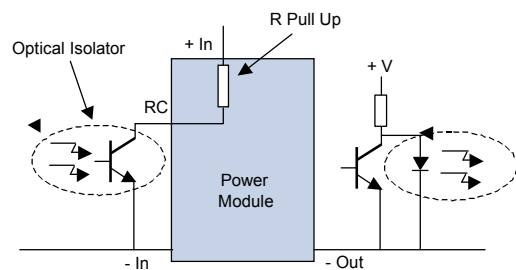


c) Negative Logic

Figure 2 - Interface circuits for isolated converters.



a) Positive Logic - Discrete



b) Optical Isolator

Formed in the late seventies, Flex Power Modules is a division of Flex that primarily designs and manufactures isolated DC/DC converters and non-isolated voltage regulators such as point-of-load units ranging in output power from 1 W to 700 W. The products are aimed at (but not limited to) the new generation of ICT (information and communication technology) equipment where systems' architects are designing boards for optimized control and reduced power consumption.

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