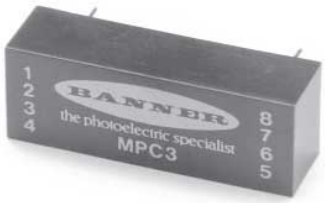
# MPC3 Miniature Modulated Amplifier

more sensors, more solutions

## Datasheet

*MICRO-AMP® System*




**WARNING:**

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

## Overview

Model MPC3 is a modulated LED photoelectric amplifier which utilizes custom CMOS integrated circuitry. It contains all the circuitry necessary to modulate nearly any LED and to amplify and demodulate the light received by a phototransistor. The outputs are conventional buffered complementary CMOS gates.

The MPC3 is designed to work with the Banner SP100 series miniature modulated remote sensors. However, it can be used with nearly any LED and phototransistor pair, as supplied by most major semiconductor manufacturers. The small size and low cost of the MPC3 permits its use in OEM equipment where conventional photoelectric controls are not justified, or where non-modulated sensors are used. Typical OEM applications include duplicating machines, semiconductor processing equipment, label sensors, vending machines, vibratory feeder controls, robotic sensors, and automatic testing equipment.

The MPC3 contains the patented Banner AID™ (Alignment Indicator Device)[1] circuitry, which shows the strength of the received signal in addition to indicating the state of the outputs. This feature permits easy setup and alignment of the sensors, and also provides a means for the ultimate user of the equipment to monitor its performance without test instruments. An LED indicator is added (externally) to utilize the AID circuitry. Amplifier sensitivity is adjusted with an external potentiometer or fixed resistor. Amplifier response speed is set at 10 milliseconds. An optional frequency control resistor ($R_r$) can be used for faster amplifier response.

The circuitry of the MPC3 is totally encapsulated in a high-impact molded polystyrene housing. It is designed for mounting directly to a printed circuit board. A set of eight closed-back pin jacks is supplied to allow the MPC3 to plug into the PC board.

[1] US patent #4356393

## Circuit Description

The functional schematic shows the MPC3 powered by 5 V DC at pin #1 and pin #3. An internal emitter oscillator generates 30 microsecond pulses at a rate of approximately 400 Hz, which are fed to the emitter at pin #5. These emitter current pulses are controlled automatically by a patented[2] power-limiting circuit that adjusts to the emitter and to the frequency in use.

The phototransistor receives the light pulses from the LED, either directly or by reflection from an object, and sends them to the input (pin #4) via the sensitivity adjustment resistor (or potentiometer). These low-level signals are amplified, separated from the emitted light, and then detected by the threshold detector. The resultant logic-level pulses are then gated synchronously with the oscillator output (to eliminate noise and interference) and demodulated. The demodulated output is then buffered and inverted, and brought to the outputs, pin #7 and pin #8. In addition, a small amount of hysteresis is fed back to the threshold detector to assure clean, bounce free output switching. The amplified signal is also fed through a negative peak detector and to a voltage-controlled oscillator whose output frequency is directly proportional to signal strength. This is the patented Banner AID™ feature which flashes the LED indicator at a rate which is proportional to the strength of the received light.

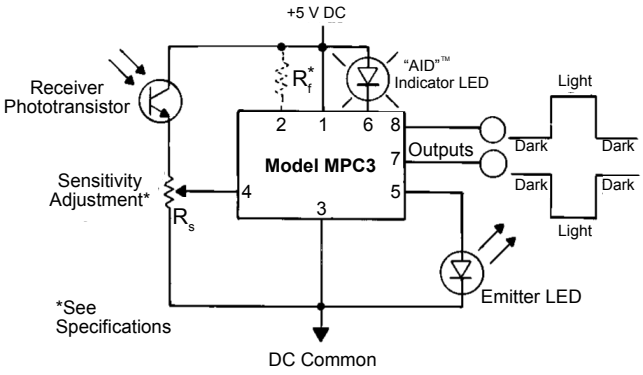
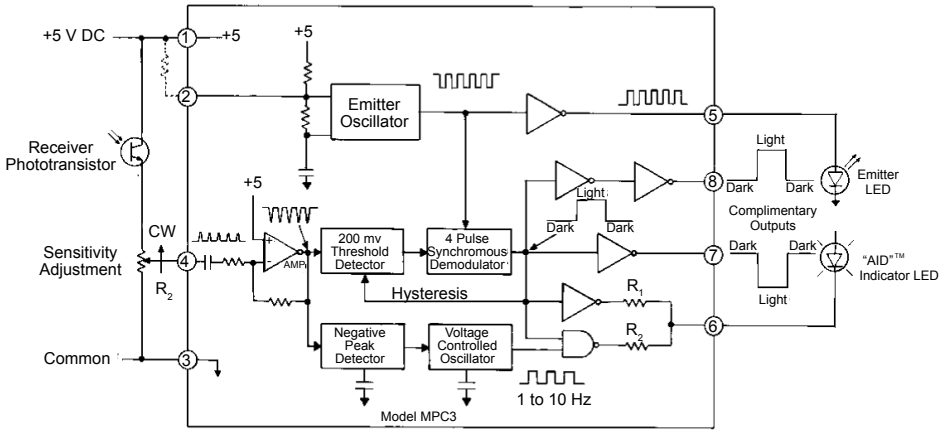



*Figure 1. Wiring Diagram*



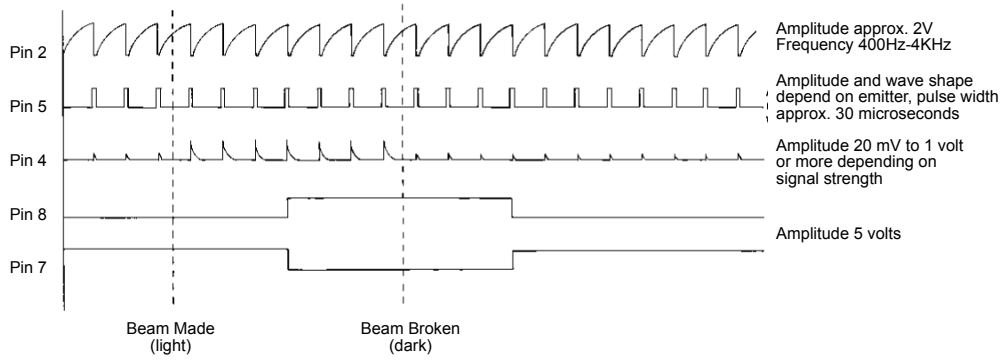




*Figure 2. Functional Schematic*

[2] US patent #4598198

## Specifications

**Supply Voltage**
5 V DC ±10% at less than 20 mA
100 mV maximum ripple
Voltage must not exceed 6 V DC or be connected in reverse polarity
Install a 0.1 microfarad capacitor as close as possible to the supply pins of the MPC3 (across pins 1 and 3) if voltage transients are anticipated

**Output Configuration**
Outputs at pin 7 and pin 8 are conventional CMOS buffered gates
Output at pin 7 is high in the DARK condition and low in the LIGHT condition
Output at pin 8 is low in the DARK condition and high in the LIGHT condition
Each output will produce several milliamps at PNP or NPN

**Output Protection Circuitry**
Protected against output short-circuit
The outputs may be shorted to either the positive or negative supply line without damage
The emitter output at pin 5 is internally current-limited, and may be grounded indefinitely
The AID output at pin 6 is internally current-limited, and may be connected to the positive supply indefinitely

**Indicator**
A constant current output is provided at pin 6 for a customer-supplied indicator LED
This current is held to only a few milliamps in order to minimize power supply requirements

**Sensitivity Adjustment**
The value of the sensitivity adjustment potentiometer, or of the fixed resistor if sensitivity adjustment is not anticipated, is 2000 ohms (2 kΩ)

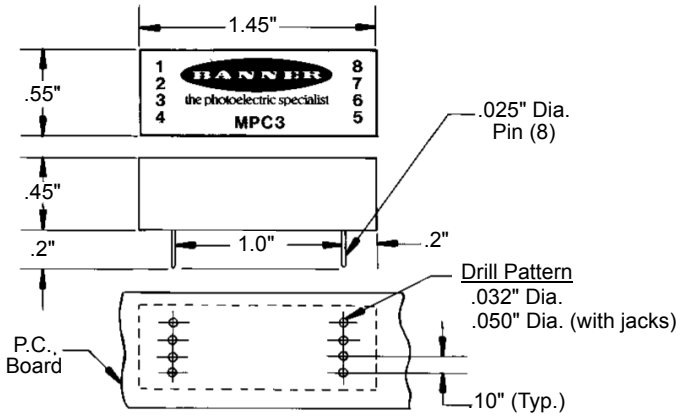
**Frequency Adjustment**
The response time of the circuit is 10 milliseconds or 4 oscillator pulses. Because the demodulator is digital, faster response times are possible by simply increasing the frequency of the emitter oscillator. This is done by installing a resistor (Rf) from pin 2 to the positive supply (pin 1). The value of the resistor is best determined empirically, by observing the signal at pin 5 (with respect to ground) on an oscilloscope. The response time of the MPC3 is equal to the time required for four pulses, and the repeatability of the response time is the time for one pulse. The approximate value of Rf is 390 kΩ for 5 millisecond response, and 39 kΩ for 1 millisecond response.
An internal emitter oscillator generates 30 microsecond pulses at a rate of about 400 Hz. When the frequency of the emitter oscillator is increased, the automatic emitter power control reduces the magnitude of the pulse current to the emitter so that it will not be damaged by the increased duty cycle. As a result, the excess gain (and the range) of the sensors is automatically reduced. For this reason, the MPC3 should be operated at the lowest frequency (response time) that is consistent with the application requirements.

**Construction**
Totally encapsulated circuitry in molded high-impact polystyrene housing
Closed-end jacks for PC plug-in mounting are included

**Operating Temperature**
–40 °C to +70 °C (–40 °F to +158 °F)

## Dimensions

All measurements are listed in inches, unless noted otherwise.

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