MAGNETICS®
Division of Spang & Company

BULLETIN NO. RC-1

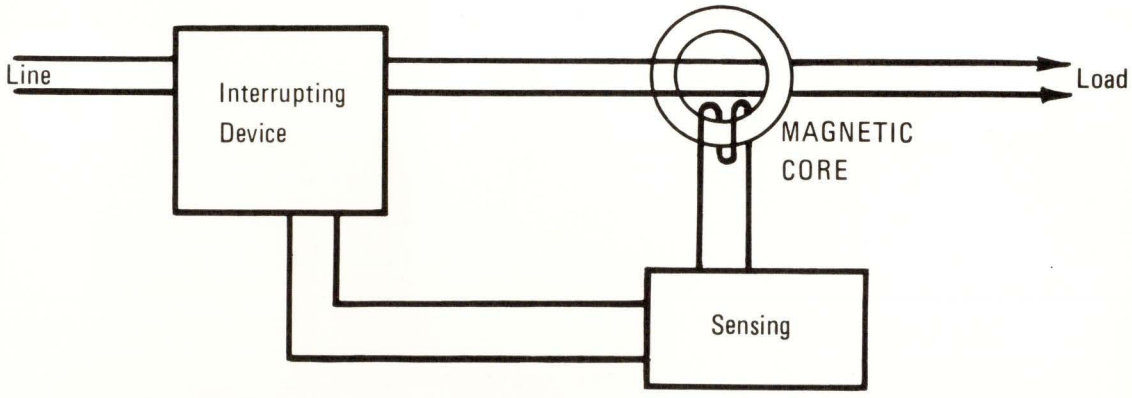
Technical Bulletin

MAGNETIC CORES FOR GROUND FAULT DETECTORS

GFCI - GFI - GFD - whatever the name is, they all mean sentries of the electric shock. Ground fault circuit interrupters - ground fault interrupters - ground fault detectors - have altered the potential hazards of electrical outlets. These sentries provide protection against serious injury or death caused by contact with damaged or defective electrical equipment. The use of these safety devices is being accelerated by the National Electrical Code of January 1, 1973 and Occupational Safety and Health Administration (OSHA) Regulations.

Essentially, a GFI compares the currents in milliamps entering and leaving a circuit; if they are not identical, it indicates that some current is leaking to the ground. The GFI, upon sensing a leak, trips the circuits and turns off the power within 25 milliseconds. Although this is not quite fast enough to avoid feeling shock, it is fast enough to save one's life.

In general, all ground fault circuit interrupters are basically the same, although individual devices may have different characteristics. Typically, the ground fault portion of a GFI consists of a sensor, an amplifier, and a tripping mechanism. The line and load wires pass through the sensor core. Since a magnetic field is generated around any wire carrying a current, the current normally flowing through the line and load wires, at any one instant, is equal, and the magnetic fields cancel each other; the sensor detects no imbalance, and no current flows in the secondary. When a small fault between a hot line and ground occurs, the amount of fault current flowing depends upon the impedance of the ground path. The resulting magnetic field, which occurs when the line current exceeds the returning current through the sensor, generates a voltage in the sensor core, causing current to flow in the secondary winding. The GFI is designed to react to a current imbalance as low as 5 ma. The imbalance is then amplified and fed to a solenoid, whose plunger trips the circuit breaker mechanically, opening the circuit to the load. Below is a simplified diagram of a ground fault detector.



The heart of a ground fault detector is a high initial permeability magnetic core with a sensitivity capable of detecting minute differences in currents entering and leaving a load. The following are typical core requirements for meeting GFI specifications:

1. μ_{40} greater than 40,000 over a temperature range of −35 °C to 70 °C.
2. μ_{40} greater than 40,000 after a three oersted shock at room temperature.

To provide the greatest sensitivity at 40 gauss and 60 Hz, MAGNETICS Permalloy 80 is an ideal material, and is specially selected and processed to meet the core requirements. Changes in temperature characteristics and D. C. shock are smallest when Permalloy 80 is formed into ring laminations which are then stacked to form a core inside a protective box. Typically, four or nine rings of 14 mil material are stacked inside a glass-filled nylon core box.

Below are Magnetics part numbers and sizes for the sensing core: (Tooling for other sizes can readily be made). Ferrites may also be used.

CORE NUMBER	CORE DIMENSIONS			CASE DIMENSIONS		
	ID	OD	HT	ID min.	OD max.	HT max.
56153-7D-01*	.375″	.500″	.125″	.305″	.570″	.200″
56822-7D-07**	.348″	.480″	.056″	.290″	.540″	.115″
*Cores are stacked with 9 rings, each ring .014″ thick **Cores are stacked with 4 rings, each ring .014″ thick				Case Material - Glass filled nylon (Type RF-1006 with 30% glass fill)		

As mentioned earlier, individual GFI circuits may have different characteristics. Some circuits use what is known as ground neutral detector circuits, and these may take different forms. However, most of these circuits will use strip or tape wound cores, or ferrite cores.

Magnetics can supply a wide variety of sizes to fill any special circuit requirement. Additional information on these cores is available in the MAGNETICS Tape Wound Core catalog TWC-300, or the MAGNETICS Ferrite Cores catalog FC509.

Listed below are Magnetics part numbers and sizes for typical neutral detector cores. Other sizes are also available.

CORE NUMBER	NOM. CORE DIMENSIONS		
	ID	OD	HT
XJ-41303-TC (ferrite)	.312″	.500″	.125″
XJ-41506-TC (ferrite)	.290″	.520″	.156″
XJ-41605-TC (ferrite)	.350″	.625″	.185″
54912-2K (tape core)	.313″	.531″	.375″
54740-2K (tape core)	.313″	.500″	.125″

LET MAGNETICS GO TO WORK FOR YOU!

EXPERIENCE. Since 1949, Magnetics has been a major producer of specialized magnetic materials and components for complex electrical apparatus. Tape wound cores and laminations are the original product lines of the company. To provide the ultimate in magnetic properties, and to guarantee magnetic performance, sophisticated equipment like special annealing furnaces, and accurate, expensive magnetic testing devices are used. Using the latest powder metallurgy techniques pioneered in Magnetics own modern research laboratories, Magnetics for years has produced its own magnetic alloys used in core products. These facilities, combined with a high degree of technical know-how have made Magnetics decidedly superior in the marketing of magnetic components.

RESEARCH. Magnetics is backed up by an extensive research department, where individual technical attention is provided for production or special problems. Facilities and technical personnel are available to give customer engineering assistance and to supply special parts or special testing.

QUALITY. Quality is assured from raw metal to finished parts. Visual, dimensional, physical and magnetic properties are a rigorous part of the testing program. Test data can be certified for these properties or any other special requirements.

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Producer of Tape, bobbin, powder cores • Ferrites