■ DC & Low Frequency AC Bias Effects And Saturation (直流電極低頻交流偏壓和飽和)

The performance of any magnetic material will be degraded if it is operated under large DC or low frequency AC bias. Under "small" bias conditions, increasing the applied magnetomotive force E applied to a magnetic core device induces a corresponding increase in magnetic flux F in the core. At some value of E the magnetic flux F stops increasing; increasing E beyond this value results in a rapid decrease in the permeability of the part. For this condition magnetic theory terms the device's core saturated, as it is unable to support further increases in magnetic flux with increasing magnetomotive force input.To illustrate, saturation may occur if a ferrite core is placed around a single output wire of a DC power supply as shown in Figure 5. In this situation, the core will experience a large DC magnetizing force. If the current is sufficient, the core will operate in the saturation region of its B-H characteristic, as shown in Figure 3. Since the slope of the B-H curve is nearly flat (=0) in saturation, the instantaneous relative permeability (equal to the slope at the operating point) of the core will drop to a value of approximately 1, or that of free space. Since the desirable lossy characteristics cof EMI suppression ferrites require core permeability >>1, the core will provide little noise attenuation if operated near or in saturation.

任何磁性材料，如果是在大的直流電流或低頻交流偏壓下運作，其性能都會衰減，在"小"的偏壓狀況下，施於磁性鐵芯增加的生磁力E，會使在鐵芯中感應之磁通量 F 相對應的增加，當 E 在某個值時磁通量 F 停止增加，此時再增加生磁力，會導致元件導磁率的快速下降，此狀況在磁學上稱此為元件之鐵芯達飽和，即他無法在隨輸入之生磁力的增加而增加其磁通量，舉例而言，當一鐵氧磁體鐵芯如圖例五所示置於一直流電源供應的其中一條輸出線時，飽和即可能發生在此狀況，此鐵芯會經歷一巨大的直流磁化力，如果此電流夠大，鐵芯將在如圖例三所示之B-H特性曲。

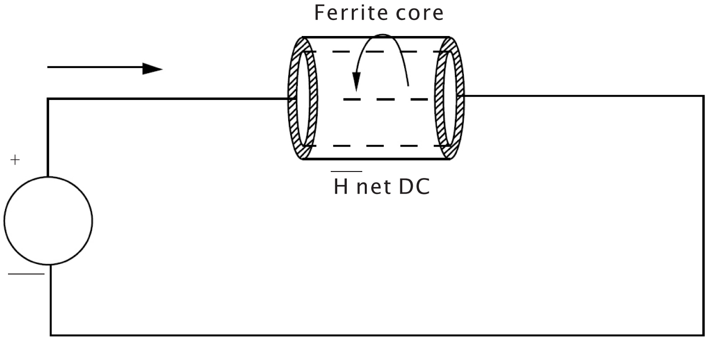

FIGURE 5: Ferrite core under DC Bias

When operated at DC bias currents grater than zero but less than the saturation bias value, EMI suppression ferrites will maintain a large lossy impedance. Since high frequency EMI filter applications depend on the lossy component of a ferrit's impedance, it is possible to use a ferrite effectively even with a significant net DC or low frequency magnetomotive force input. Many Gausstek EMI suppression ferrites maintain useful lossy impedance with forward bias currents in excess of 6000 milliamperes.

當鐵芯的直流偏壓電流在零及其飽和偏壓值之間運作時，用以抑制電磁波干擾之鐵氧磁體會維持在很高的損失阻抗，因為高頻電磁波干擾的濾波應用主要是利用鐵氧磁體阻抗的損失部份，在輸入一顯著的淨直流電或低頻生磁力之下，鐵氧磁體能仍可能有效的運作，很多豐晶科技作為抑制電磁波干擾的鐵氧磁體都具有很有用之損失阻抗，其偏壓電流可達6000毫安培。

■ DC & Low Frequency AC Bias Effects in a Board Level Application
(一般等級應用之直流電及低頻交流偏壓效應)

Gausstek ferrites deliver maximum series impedance under zero DC and low frequency AC bias; ie., when zero net flux is induced into the device by circuit bias currents. Since EMI suppression ferrites are frequently used to filter common mode EMI on conductors carrying DC or AC power, they should be applied so as to encircle pairs or groups of conductors that carry equal and opposite (balanced) low frequency (e. g., 60 Hz) alternating and direct currents. For example, suppose an EMC engineer wishes to reduce the high frequency noise on a DC power supply output cable. The engineer proposes two solutions. The first implementation, shown in Figure 6, employs two ferrite cores, one for the +5 volt conductors, and one for the "round" or power return conductors. In this case, each ferrite will be subject to a large net DC bias, which will result in a large reduction in the high frequency impedance of the ferrite, and a corresponding reduction in EMI suppression performance. In the second implementation, displayed in Figure 7, equal numbers of +5 volt and "ground" conductors are passed through a single ferrite. In this instance, the ferrite "sees' equal and opposite DC currents and thus zero net magnetic flux density.

The ferrite will be able to provide maximum series impedance for high frequency common mode currents and remain unaffected by the DC operation of the encircled conductors. Some applications may not permit a ferrite to operate under zero bias. While ferrites can still function as lossy elements with non-zero DC and low frequency flux densities, the user must be aware that the impedance of the device will decrease under such bias. This drop in impedance can be easily compensated by increasing the mass of the part.

在沒有直流或低頻交流偏壓下，亦即在沒有因電路偏壓電流而感應出磁通時，豐晶科技的鐵氧磁體提供極高的串聯阻抗，因為抑制電磁波干擾之濾波器常被應用於承載直流或交流電源的導體所產生的一般模式電磁波干擾，故其應被用於環繞成對或成群承載相等且反向(平衡的)的低頻(如60赫茲)交流或直流電流的導體，舉例來說，假設一EMC工程師希望減低一直流電源輸出線的高頻雜訊，此工程師提出兩種解決方案，第一個方案，如圖例六所示，利用兩個鐵氧磁體鐵芯，一個置於+5伏特的導線，另一個置於"接地"或電源來回的導線上，在此狀況下，每個鐵氧磁體都會承受一很大之淨直流偏壓，而導致鐵氧磁體在高頻的阻抗會有很大的降低，進而降低抑制電磁波干擾的功能，第二個方案如圖例七所示，等數的+5伏特及"接地"之導線通過同一個鐵氧磁體，如此，鐵氧磁體"視"其為等量且反向之電流，因而其淨磁通密度為零，此時，鐵氧磁體便能對高頻一般模式電流提供最大之串聯阻抗，而本身不會受到所包覆之導體上的直流電流的影響，有些應用可能無法允許鐵氧磁體在無偏壓下運作，然而，鐵氧磁體仍是可以在非零直流及低頻磁通密度下作為一損失元件，使用者必需要注意到這樣的偏壓下，元件的阻抗會降低，如此的阻抗降低通常可以簡單地以增加元件的質量來補償。