

### Background

Ground-Start is usually the primary analog signaling method used between telephone switches such as the Central Office (CO) and a Private Branch Exchange (PBX). Ground-Start provides a way to indicate on-hook and off-hook conditions in a voice network. The main difference between ground-start and loop-start (your typical home telephone service) is that ground-start requires ground detection to occur in both ends of a connection before the tip and ring loop can be closed. This is done to eliminate a condition known as "glare". Glare occurs when both ends of a telephone line or trunk are seized at the same time for different purposes or by different users.

Ground-Start supervision resolves the glare problem by utilizing a simple handshake that ensures that glare will not occur. The circuit shown in figure 1 uses a Clare IAA110 to illustrate how Ground-Start supervision can be implemented.

### Review of Ground-Start Signaling Protocol

The CO side of the circuit in figure 1 is a simplified representation used to illustrate the signaling concept. The CO side of the circuit could also represent an FXS (Foreign Exchange Station) and the CPE (Customer Premise Equipment) DAA could represent an FXO (Foreign Exchange Office).

Before describing the circuit in detail, it is helpful to review the operational states of the ground-start protocol:

#### Idle State (On-Hook)

- CPE monitors Tip lead for application of ground by CO.
- Battery from CO appears on Ring lead. CO monitors ring lead for application of ground by CPE.

#### CPE Seizes Trunk

- CPE Grounds Ring lead.
- CO senses Ring ground and in response, grounds Tip lead.
- CPE senses Tip ground from CO, closes loop, and removes Ring ground.
- Communication can now commence.

#### CO Seizes Trunk

- CO grounds Tip lead and superimposes ringing voltage over Ring lead battery.
- CPE detects Tip ground and ringing. Tip ground must be sensed within 100 mS to prevent glare condition.
- CPE closes loop.
- CO senses DC current from the CPE.
- Communication can now commence.

### Circuit Description

#### Idle state (On-Hook):

-TIP\_EN should be pulled low to activate tip ground monitoring. RING\_EN should be pulled high or left open so that Ring ground is de-activated. When -TIP\_EN is activated, relay K1 will turn on which creates a path from the CPE power supply of -48V through LED D3, R4, and D5. In the idle state, the tip lead is floating so no current will flow through this path.

#### Ring Ground Assertion:

Setting -RING\_EN low activates relay K2. K2 creates a low resistance path from the Ring lead through K2 and through R5. CO Detects current flow due to grounded Ring lead.

#### Tip Ground Detection:

CO grounds Tip lead by closing SW1 relay, current flows through the K1 relay path causing LED D3 to activate which is optically coupled to Q1. Q1 saturates causing -TIP\_DET to go low indicating that the CO has placed ground on the Tip lead. D6 protects LED D3 from high reverse voltage and also prevents LED D4 from turning on. R4 limits current to about 3 mA with a battery voltage of -48V and D5 ensures operation with the correct polarity applied to Tip and Ring leads. R3 sets turn on threshold of D3 to about 1.9 V. Note that a -48V battery voltage is not mandatory to perform the Tip ground detection, but if changing voltage, adjust R4 for approximately 3mA of current in the path.

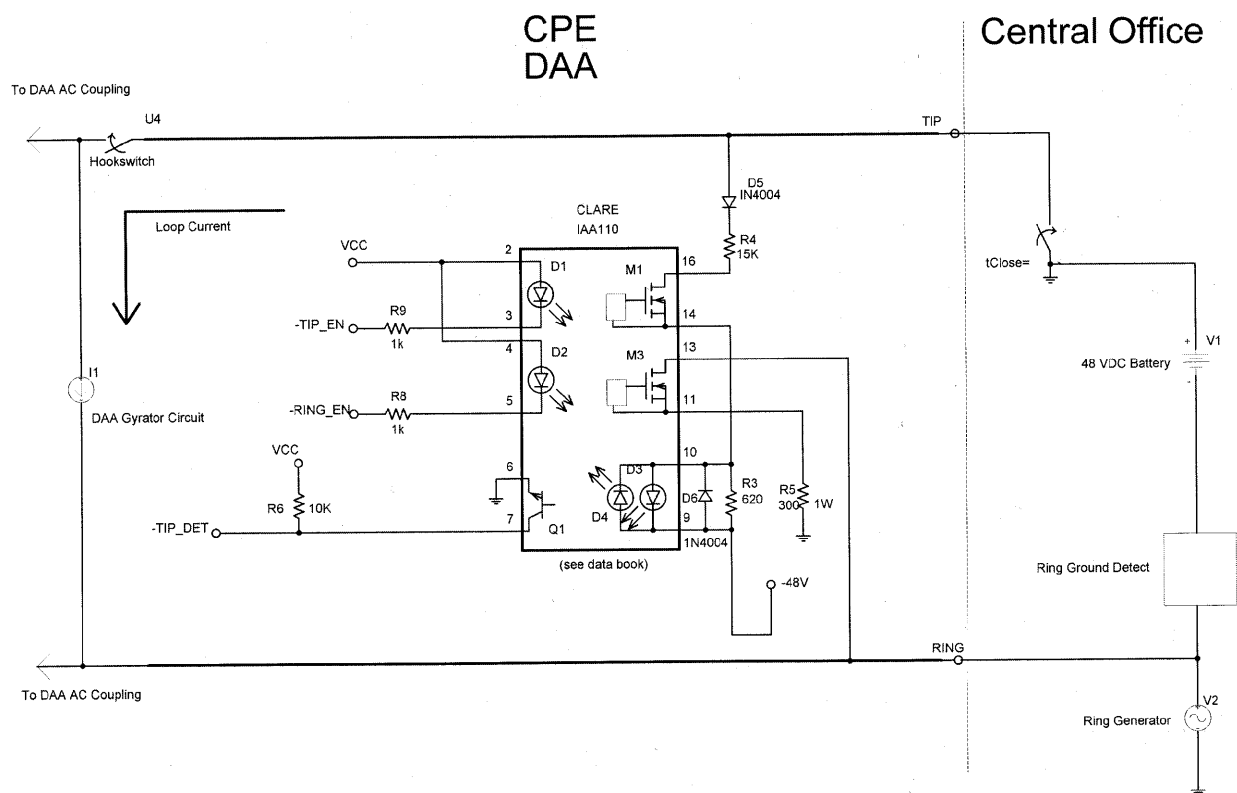
#### Important Note:

After Tip ground is detected and before loop is closed, -TIP\_EN should be de-activated which will disable the Tip ground detect circuit. Doing this preserves longitudinal balance in the communication state.

**Information Resources**

Additional information about Ground-Start signaling and associated regulatory requirements can be found in the following publications:

1. Bell System Technical Reference PUB 47001 1982
2. Code of Federal Regulations (CFR) FCC Part 68.3





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