

CTP2000 2W-FXS and 2W-FXO Interface Modules

The CTP2000 2W-FXS and CTP2000 2W-FXO interface modules provide analog support for voice applications. The 2W-FXS module has 24 two-wire FXS ports and the 2W-FXO interface module has 12 two-wire FXS ports. Both are paired with an RTM.

- FXS interfaces point to the subscriber and supply battery and ring voltage. Some FXS devices also provide dial tone, but CTP FXS interfaces do not. FXS interfaces detect when the attached FXO interface goes off-hook and on-hook. An FXS interface is a two-wire interface; the leads are called the tip (T) and the ring (R).
- FXO interfaces point to the central office. An analog phone is an example of an FXO device. The FXO interface must detect ring voltage (the analog phone rings) and provide on- and off-hook indication to the FXS interface. An FXO interface is a two-wire interface; the leads are called the tip (T) and the ring (R).

Both interface modules consist of a front module and an RTM. See Figure 1 and Figure 2 for the CTP2000 2W-FXS interface module.

Figure 1: Front Panel of CTP2000 2W-FXS Interface Module

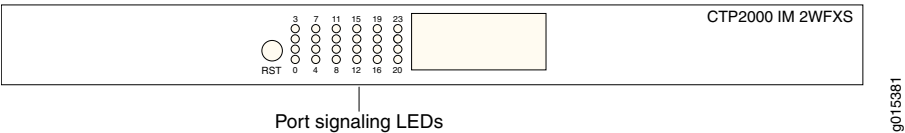
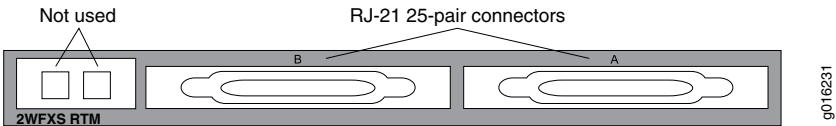


Figure 2: Rear Panel of CTP2000 2W-FXS RTM



See Figure 3 and Figure 4 for the CTP2000 2W-FXO interface module.

Figure 3: Front Panel of CTP2000 2W-FXO Interface Module

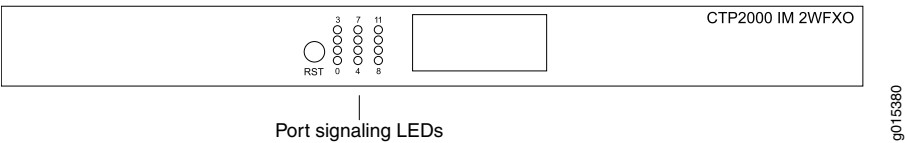
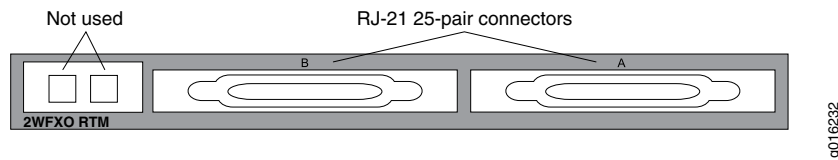


Figure 4: Rear Panel of CTP2000 2W-FXO RTM



Both modules use connector A on the RTM. For both modules, connector B and the RJ-45 connectors are not used. See CTP2000 FXS and FXO Interface Module Cables and Pinouts for connector pinout information.

You set the signaling by using the software on both modules. You cannot reconfigure the jumper parameters.

Required Cables and Pinouts

The CTP2000 2W-FXS and 2W-FXO interface modules require the use of double-shielded cables (copper braid plus aluminum mylar foil) to ensure EMI compliance. See CTP2000 FXS and FXO Interface Module Cables and Pinouts for particulars about cable pinouts.

Analog FXS/FXO Loop-Start Signaling

There are two basic signaling protocols for FXS/FXO interfaces: loop-start and ground-start. Residential telephones use loop-start. Ground-start is typically used between a CO and a PBX to prevent “glare.” Glare occurs when a call is established by the FXS device and the FXO device tries to make a call before the ring has been detected.

When a call is initiated from the CO (or FXS) side, the FXS interface puts an AC ring voltage on the R lead (typically 70-90 Vrms). This ring voltage generates the ringing that you hear on an analog phone. When the FXO device answers the call (someone picks up the handset), the switch is closed between the T and R leads to complete a loop between the battery and ground in the FXS device. The FXS device detects the current, which flows from the battery (–48 V) through the R leads and back through the T leads to ground and stops the ring voltage.

When a call is initiated by the CPE (or FXO) device, the device goes off-hook, closing the connection between the T and R leads. The FXS device senses the current flow in the loop. Either the attached FXS device, or an upstream FXS device, provides dial tone to the FXO device after it is ready to accept the digits for the call destination. Providing dial tone is a form of start-dial supervision.

On the FXO device, when the device is on-hook, there is an open lead between the T and R leads. When the device is off-hook, the T and R leads are shorted with a typical load of ~ 300 Ohms. With loop-start, the T and R leads on the FXO interface can be switched without adversely affecting the signaling.

Glare occurs when a call is established by the FXS device and the FXO tries to make a call before the ring has been detected. Because it takes time for the FXO device (or person about to place a call) to detect ringing, it is possible for the FXS and FXO devices to both seize the line without knowledge that the other end has done so.

Ground-start circuits were established to minimize the possibility of glare. See “Analog FXS/FXO Ground-Start Signaling” on page 3.

Answer Supervision

Answer supervision is a signal used by the phone companies to determine when to start billing the originator of the call. Without answer supervision, you could get billed for the time the phone was ringing, even if the call was never picked up. When the FXS device has detected that the FXO device has gone off-hook, it reverses the polarity between the T and R leads for the duration of the call.

Disconnect Supervision

Disconnect supervision is a signal sent by the FXS device to the FXO device to indicate that the call has ended. The disconnect supervision signal can be either a battery reversal, battery denial (more than 350 ms), or a tone.

Note that loop-start circuits are not sensitive to tip/ring reversal. For example, the tip on the FXO device may be connected to either the tip or ring on the FXS.

Analog FXS/FXO Ground-Start Signaling

Ground-start signaling is used to minimize the potential for glare. Unlike loop-start circuits, ground-start circuits operate correctly only when the FXO tip is connected to the FXS tip and the FXO ring is connected to the FXS ring. Also, unlike loop-start circuits, the FXS and FXO grounds must be at the same potential.

When on-hook, the FXO ring is not connected to either the tip or ground. Likewise, when idle, the FXS tip is not connected to ground. When a call is initiated from the CO (FXS side), the FXS grounds its tip and applies an AC ring voltage to the R lead. The FXO device senses the grounded tip and AC ring voltage, and then goes off-hook by closing the loop (connecting R to T). The FXO has 100 ms to respond to the grounded tip/ring voltage. This time constraint is used to minimize glare. Once the FXO has closed the loop, the call proceeds as in the loop-start case.

When a call is initiated by the customer (FXO) side, the FXO starts by grounding the R lead. The FXS side responds by grounding its T lead. After the FXO has detected the grounded T lead, it closes the loop by removing the R lead from ground and closing the loop. With ground-start circuits, a far-end disconnect (FXS side) is indicated by the FXS disconnecting the tip from ground. The FXO senses the tip disconnect and goes on-hook by opening the loop.

Digital Signaling

Channel banks are often used to multiplex and demultiplex FXS or FXO interfaces onto T1 or E1 digital circuits. In the process, the analog signal is converted into pulse code modulation (PCM) and carried by one of the channels in the time-division multiplexing (TDM) circuit. For the interface to function properly, it must be able to signal the remote end of the T1/E1 connection as well as respond to signals from the remote end. Signaling is carried over the TDM circuit using either channel-associated signaling (CAS) or common-channel signaling (CCS). Generally,

four signaling bits (A, B, C, and D) may be used; however, two signaling bits are most common (A and B).

For CTP analog voice products to work with digital devices, A and B bits are generated and transported across the network.

Digital FXS/FXO Loop-Start Signaling

For loop-start signaling of FXS and FXO interfaces, the A bit is used to indicate the state of the current loop, whereas the B bit is used for ringing. In the idle state (no ringing, FXO on-hook), A = 0 and B = 1. A = 1 when the FXO is off-hook. Ringing is signaled by the B bit toggling between 0 and 1. Typically the toggling is 2 seconds off and 4 seconds on. For digital loop-state, the signaling is bidirectional.

Because hook indication is detected by the analog FXS interface, this device is responsible for generating the A bit. Likewise, because the analog FXS interface generates the ring voltage, this device must respond to the B bit. Because the signaling is bidirectional, the FXS side must echo the B bit when sending out the A bit.

The same logic applies to the FXO interface. The FXO device goes on/off-hook. It must respond to the A bit, going off-hook when A transitions from 0 to 1, and going on-hook when A goes from 1 to 0. The analog FXO interface detects ringing; therefore, it is responsible for generating the B bit value. The FXO device must echo the A value when sending out the digital signaling over the network.

Two situations for this call sequence must be considered: when the CTP is the FXO device and when the CTP platform is the FXS device. In both cases, before the call starts, the FXO is on-hook (A = 1) and there is no ringing (B = 1).

- For an analog CTP FXS interface, before the call starts, the CTP interface must generate A = 0 and send both A = 0 and B = 1. When the call initiates from the CO, the B bit is toggled. In response to this toggling, the CTP device generates a ring voltage on the analog FXS interface. When the attached FXO device goes off-hook, the CTP FXS interface detects the off-hook, sets the A bit to 1, and stops the ring voltage. During the call, the CTP device sends A = B = 1 signaling bits. At the end of the call, the FXO device goes back to on-hook, the CTP detects the on-hook, sends out A = 0 and B = 1 signaling bits, and the circuit returns to the idle state.
- For an analog CTP FXO interface, before the call starts the FXO is on-hook and no ringing is generated by the attached FXS device. In this, the idle state, the CTP interface generates B = 1 and sends both A = 0 and B = 1. When the call comes in from the CO, the CTP FXO interface detects ring voltage and starts toggling the B bit. When the other end of the VCOMP bundle goes off-hook, it sends A = 1 to the CTP. In response, the CTP FXO interface closes the loop, going off-hook. With ringing stopped, the CTP interface sends A = B = 1 during the call. At the end of the call the interface is again idle, and the CTP interface sends A = 0 and B = 1 signaling bits.

Digital FXS/FXO Ground-Start Signaling

Unlike loop-start interfaces, in which the FXO and FXS each separately control a single signaling bit, with ground-start signaling each side controls both the A and B

bits. We must consider each interface when the call is initiated by either interface. (See Table 1, Table 2, Table 3, and Table 4). In all cases, when the FXO/FXS interface is idle, the FXO interface generates $A = B = 1$ signaling bits and the FXS $A = 0, B = 1$. When a call is in progress, either side initiates a call termination if it receives these signaling bits. For example, an FXS goes on-hook if it receives $A = B = 1$ signaling bits.

Table 1: Ground-Start Signaling at FXO Interface for Call Initiated by the FXO Interface

	Signaling Bits to FXO	Signaling Bits from FXO
Idle (before call starts)	01 ($A = 0, B = 1$)	11 ($A = 1, B = 1$)
FXO grounds ring	00	11
FXS goes off-hook (grounds tip)	00	01
FXO goes off-hook (closes loop)	11	01
Duration of call	11	01

Table 2: Ground-Start Signaling at FXO Interface for Call Initiated by the FXS Interface

	Signaling Bits to FXO	Signaling Bits from FXO
Idle (before call starts)	01 ($A = 0, B = 1$)	11 ($A = 1, B = 1$)
FXS goes off-hook (grounds tip and sends AC ring signal)	01	00/01 (B-bit toggles)
FXO goes off-hook (closes loop)	11	01
Duration of call	11	01

Table 3: Ground-Start Signaling at FXS Interface for Call Initiated by the FXS Interface

	Signaling Bits to FXS	Signaling Bits from FXS
Idle (before call starts)	11 ($A = 1, B = 1$)	01 ($A = 0, B = 1$)
FXS goes off-hook (grounds tip and sends AC ring signal)	00/01 (B-bit toggles)	01
FXO goes off-hook (closes loop)	01	11
Duration of call	01	11

Table 4: Ground-Start Signaling at FXS Interface for Call Initiated by the FXO Interface

	Signaling Bits to FXS	Signaling Bits from FXS
Idle (before call starts)	1 1 (A = 1, B = 1)	0 1 (A = 0, B = 1)
FXO grounds ring	1 1	0 0
FXS goes off-hook (grounds tip and sends AC ring signal)	0 1	0 0
FXO goes off-hook (closes loop)	0 1	1 1
Duration of call	0 1	1 1

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