6
MCU MODE ACTIVATION AND DEACTIVATION

6.1 INTRODUCTION

This section describes the activation and deactivation procedure for the MC145572. It is assumed that the MC145572 is configured for IDL2 mode of operation. The material covered in this section is useful for all applications. It is strongly recommended that this section be read when GCI mode operation is to be used. **Section 8** gives a detailed functional description of GCI mode operation including the activation and deactivation time flow diagrams.

Activation or start–up is the process U–interface transceivers use to initiate a robust full–duplex communications channel. This process, which may be initiated from either the LT or the NT mode U–interface transceiver, is a well–defined sequence of procedures during which the training of the equalizers and echo cancelers at each end of the transmission line takes place. Two types of activation, cold start or warm start, may occur. The MC145572 is capable of automatically supporting both types.

Deactivation is the process used to gracefully end communication between the U–interface transceivers at each end of the transmission line. Only the LT mode U–interface transceiver may initiate a deactivation procedure.

ANSI T1.601–1992 defines ten activation signals, described in Tables 6–1 and 6–2, for the U–interface transceivers to use during the activation procedure. For instance, six basic frames of signal TN are transmitted by the NT when it wants to wake up the LT or in response to the LT transmitting TL. Two basic frames of signal TL are transmitted by the LT when it wants to wake up the NT. When the NT is in the fully operational mode, it transmits the signal known as SN3 and receives SL3 from the LT end. Conversely, when the LT is in fully operational mode it transmits SL3 and receives SN3. Only when the U–interface is fully activated, with the NT transmitting signal SN3 and the LT transmitting SL3, are the 2B+D channels of data capable of being transmitted over the U–interface.

ANSI T1.601–1992 defines the M4 channel `act` bit, see BR0(b7) and BR1(b7), which signals the far end U–interface transceiver that the near end is capable of transparently passing 2B+D data. Figure 6–1 shows the activation diagram from the ANSI T1.601 specification. This figure can be used in conjunction with this text to understand the activation sequence.

6.2 ACTIVATION SIGNALS FOR NT MODE

When configured as an NT, the MC145572 U–interface transceiver can transmit any of the signals shown in Table 6–1. The actual procedure undertaken by the device using these five signals is described later in this section. **Section 4.4.9**, BR9 description, describes how to control the transmit framer when it is desired to generate signals for test purposes.

Table 6–1. NT Mode Activation Signals

Information Station	Description
TN	A 10 kHz tone consisting of alternating four +3 quats followed by four –3 quats for a time period of six frames.
SN0	No signal transmitted.
SN1	Synchronization word present, no superframe synchronization word (ISW), and 2B+D+M = 1.
SN2	Synchronization word present, no superframe synchronization word (ISW), and 2B+D+M = 1.
SN3	Synchronization word present, superframe synchronization word (ISW) present. M channel bits active. Transmitted 2B+D data operational when M4 `act` bit = 1. When M4 `act` = 0, transmitted 2B+D data = 1.

6.3 ACTIVATION SIGNALS FOR LT MODE

When configured as an LT, the MC145572 U–interface transceiver can transmit any of the signals shown in Table 6–2. The actual procedure undertaken by the device using these five signals is described later in this section. **Section 4.4.9**, BR9 description, describes how to control the transmit framer when it is desired to generate signals for test purposes.

Table 6–2. LT Mode Activation Signals

Information Station	Description
TL	A 10 kHz tone consisting of alternating four + 3 quats followed by four – 3 quats for a time period of two frames.
SL0	No signal transmitted.
SL1	Synchronization word present, no superframe synchronization word (ISW), and 2B+D+M = 1.
SL2	Synchronization word present, superframe synchronization word (ISW) present, 2B+D = 0, and M = Normal.
SL3	Synchronization word present, superframe synchronization word (ISW) present. M channel bits active. Transmitted 2B+D data operational when M4 `act` bit = 1. When M4 `act` = 0, transmitted 2B+D data = 0.

6.4 ACTIVATION INITIATION

The MC145572 U–interface transceiver can be activated in either of two ways. The external microcontroller can explicitly issue Activation Request (NR2(b3) = 1) or the transceiver detects an incoming 10 kHz wake–up tone. An LT configured U–interface transceiver searches for an NT sending the TN wake–up tone. An NT configured U–interface transceiver searches for an LT sending the TL wake–up tone. In IDL2 mode the Activation in Progress status bit (NR1(b0)) is set to a 1 when an incoming 10 kHz wake–up tone is detected. In either case, Activation Request being set or a wake–up tone being detected, the U–interface transceiver proceeds with activation automatically and signals the result of the activation to the external microcontroller by setting status bits in NR1 to $B.

An NT configured U–interface transceiver always initiates activation by sending a TN tone to the LT. This is done in response to the LT sending a TL or when the Activation Request bit (NR2(b3)) is set to a 1.

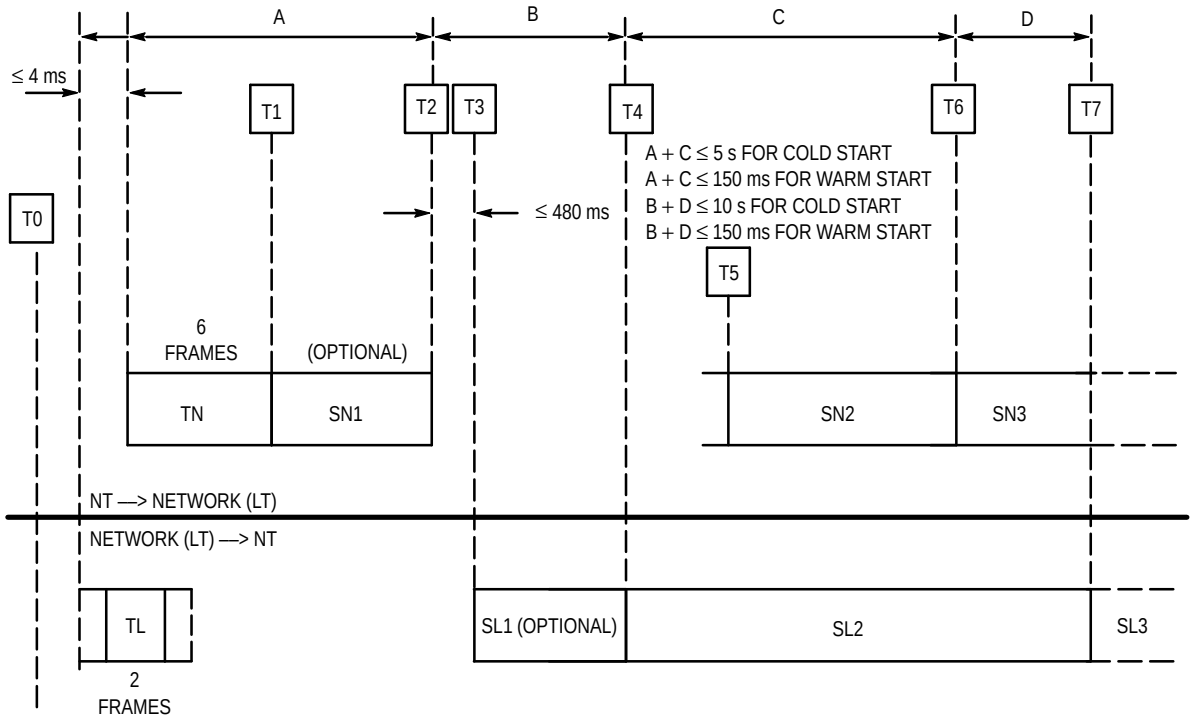
An LT configured U–interface transceiver initiates activation by sending the TL tone when the Activation Request bit is set to 1 by an external microcontroller. The NT U–interface transceiver responds to the TL tone by sending a TN tone back to the LT U–interface transceiver. Otherwise, the LT U–interface transceiver waits for an unsolicited incoming TN tone from the NT U–interface transceiver and self–activates. Regardless of how activation is initiated, the LT U–interface transceiver automatically activates from the point where it detects the incoming TN tone from the NT transceiver.

When configured for MCU Mode, all appropriate maintenance channel registers should be initialized prior to setting Activation Request (NR2(b3)) or immediately after detecting Activation In Progress (NR1(b0)) = 1. In GCI mode the MC145572 automatically initializes the maintenance channel registers.

Some applications such as U repeaters may require longer activation times than 15 seconds. The 15 second activation timer can be disabled by setting Activation Timer Disable (BR11(b0)) to 1.

6.5 ACTIVATION OF U-INTERFACE BY NT

NT mode activation initiation is accomplished by setting Activation Request (NR2(b3)) to a 1. The NT U–interface transceiver initiates activation of the U–interface by transmitting TN for a time period of six frames (9 ms) toward the LT. At this time, the NT U–interface transceiver also sets Activation in Progress (NR1(b0)) to 1. Transmission of TN is immediately followed by transmission of SN1 while the echo cancelers are trained.



Time	Description of Event or State
T0	RESET state.
T1	Network and NT are awake.
T2	NT discontinues transmission, indicating that NT is ready to receive signal.
T3	Network responds to termination of signal and begins transmitting signal toward the NT.
T4	Network begins transmitting SL2 toward the NT, indicating that the network is ready to receive SN2.
T5	NT begins transmitting SN2 toward the network, indicating that the NT has acquired SW frame and detected SL2.
T6	NT has acquired superframe marker, and is fully operational.
T7	Network has acquired superframe marker, and is fully operational.

Figure 6–1. ANSI U–Interface Transceiver Activation State Diagram

From Figure 6–1 it can be seen that the NT transceiver has a period of time during activation where the LT end is guaranteed to be quiet. This is to permit the MC145572 to train its echo cancelers during the transmission of SN1.

After the MC145572 ends transmission of SN1 it waits up to 480 ms for the LT to transmit a signal, SL1 or SL2. The MC145572 then recovers timing information and transmits SN2. When full duplex operation has been achieved, bits NR1(b3, b1, b0) are each set to 1 and SN3 is enabled for transmission. SN3 is transmitted with only the maintenance channel bits active until transparent 2B+D transmission is enabled by setting Customer Enable (NR2(b0)) to 1, or the M4 channel `act` bit has been received when the MC145572 is configured for the Verified `act` mode. See BR9(b5,b4) for more about Verified act.

If SN3 is not reached within 15 seconds, activation is automatically aborted, Error Indication (NR1(b2)) is set to 1, and bits NR1(b3, b1, b0) are each reset to 0. The 15 second activation timer is started when Activation in Progress (NR1(b0)) is set to 1. The Activation Request bit (NR2(b3)) is internally reset to 0 when Activation in Progress (NR1(b0)) is set to 1.

6.6 ACTIVATION OF U-INTERFACE BY LT

LT mode activation initiation is accomplished by setting Activation Request (NR2(b3)) to a 1. The LT initiates activation of the U–interface by transmitting TL for a period of two frames (3 ms) toward the NT. At this time, the LT U–interface transceiver also sets Activation in Progress (NR1(b0)) to 1. After

the LT stops sending TL the NT transmits TN and SN1 and trains its echo cancelers. The LT then waits for loss of the far end signals, TN and SN1.

Loss of TN and SN1 reception is immediately followed by the LT transmission of SL1 while the LT end echo cancelers are trained. From Figure 6–1 it can be seen that the LT transceiver has a period of time during activation where the NT end is guaranteed to be quiet. This is to permit the MC145572 to train its echo cancelers during the transmission of SL1 and part of SL2. During SL2 the MC145572 looks for a far end signal. The MC145572 then recovers timing information and trains for full duplex operation. When full duplex operation has been achieved, NR1(b3, b1, b0) are each set to 1 and SL3 is transmitted with the M channel bits active. The 2B+D channels become active when Customer Enable (NR2(b0)) is set to 1.

If activation continues for more than 15 seconds it is aborted, Error Indication (NR1(b2)) is set to 1, and bits NR1(b3,b1,b0) are each reset to 0. The 15 second activation timer is started when Activation in Progress (NR1(b0)) is set to 1. Activation Request (NR2(b3)) is internally reset to 0 when Activation in Progress (NR1(b0)) is set to 1.

6.7 ACTIVATION INDICATION

The Linkup status bit (NR1(b3)) is used to signify that the loop is active. With the MC145572 configured as an NT, this corresponds to the NT transmitting SN3 and receiving SL3. With the MC145572 configured as an LT this corresponds to the LT transmitting SL3 and receiving SN3. When the U–interface is fully active, Superframe Sync (NR1(b1)) and Linkup (NR1(b3)) are set to 1.

When the LT U–interface transceiver is activated and ready to pass 2B+D data, the M4 channel `act` bit should be set per ANSI T1.601–1992. This is done by setting BR0(b7) to 1. Also, it is required that Customer Enable (NR1(b0)) be set to 1 when the M4 channel verified `act/dea` mode is not enabled. This must be done after activation from the receive RESET state. Refer to **Section 4.10**, BR9, for more details on Verified `act/dea` and control of the M4 channel bits.

Whenever the MC145572 detects loss of superframe synchronization NR1 becomes $8 and an interrupt is generated if enabled. This indicates that loss of superframe synchronization has been detected. When superframe synchronization is lost for more than 480 ms, the MC145572 always deactivates and sets NR1 = $4, error indication, and issues an interrupt if enabled. When the error condition causing loss of superframe synchronization goes away before 480 ms has elapsed, NR1 returns to $B and an interrupt is generated if enabled. It is not necessary to set Customer Enable (NR2(b0)) to a 1 when NR1 returns to $B.

The MC145572 continually monitors the error on its recovered signal. If the internally monitored error rate becomes too large the MC145572 loses data transparency and NR1 changes to $A or $8 and issues an interrupt. Note that loss of superframe synchronization always means that data transparency is lost, but loss of data transparency does not always mean that superframe synchronization is lost. Also, note that loss of signal always means that superframe synchronization is lost. There is no time limit on how long NR1 may read as $A when data transparency is lost. There is a 480 ms time limit on NR1 reading as $8. ANSI T1.601 only indicates that U–interface transceivers must deactivate when superframe synchronization or receive signal is lost for more than 480 ms. If the error condition goes away, NR1 returns to $B and an interrupt is generated if enabled.

Loss of superframe synchronization may be due to a high internally detected error rate on recovered data or the temporary loss of received signal.

6.8 NT DEACTIVATION PROCEDURES AND WARM START

ANSI T1.601 specifies that the NT cannot initiate deactivation. The MC145572 deactivates to a warm start condition when Deactivation Request (NR2(b2)) is set to 1 prior to the LT deactivating the U–interface. This should be done in response to the M4 channel `dea` bit being received as 0 by the NT when the loop is active. If Deactivation Request (NR2(b2)) is not set to 1 before the LT deactivates the U–interface, the MC145572 deactivates to a cold start condition and gives an error indication interrupt. Deactivation Request is automatically set if the M4 maintenance bits are operated with automatic verification of activation and deactivation. So when the LT deactivates the line, the NT deactivates to warm start condition. See BR9(b5:b4) and OR7(b0) for more information.

6.9 LT DEACTIVATION PROCEDURES

ANSI T1.601 specifies that only the LT can deactivate the U–interface. This is done in the MC145572 by setting Deactivation Request (NR2(b2)) to 1.

Prior to deactivating, the LT should notify the NT of the pending deactivation by clearing the M4 channel dea bit towards the NT for at least three superframes. Then, deactivate the LT by setting Deactivation Request (NR2(b2)) to a 1.

The MC145572, when configured as an LT, has a mode in which the M4 channel can be updated and sent for exactly three superframes before deactivation occurs. This is done in the following manner. Set Superframe Update Disable (NR2(b1)) to 1 to disable maintenance channel updates. Reset the M4 channel dea bit (BR0(b6)) to 0 to indicate that the LT initiated deactivation. Reset Superframe Update Disable (NR2(b1)) to 0 and simultaneously set Deactivation Request (NR2(b2)) to 1 to re–enable maintenance channel updates and initiate deactivation. The LT U–interface transceiver then updates the maintenance channel Superframe Framer bits and sends exactly three superframes with the M4 channel dea bit reset to 0. The U–interface transceiver then deactivates per ANSI T1.601–1992.

6.10 INITIAL STATE OF B1 AND B2 CHANNELS

The MC145572 comes out of hardware or software reset with customer data disabled. This corresponds to Customer Enable (NR2(b0)) reset to 0. When the M4 channel verified act/dea mode is not used it is required that Customer Enable (NR1(b0)) be set to 1 to enable data transparency when NR1 becomes $B after initial activation. The B1, B2, and D channels transmitted on the IDL interface are automatically enabled after the MC145572 activates. Data on the B1 channel from the U–interface corresponds to data in the B1 channel timeslot on the IDL interface and data on the B2 channel from the U–interface corresponds to data on the B2 channel timeslot on the IDL interface. The B1 and B2 channel timeslots on the IDL interface can be swapped by setting Swap B1/B2 (NR5(b0)) to 1.

6.11 ADDITIONAL NOTES

6.11.1 Maintenance Channel Bits

The received eoc, M4, M5, and M6 channel bits are available in registers R6, BR1, and BR3 once Linkup has been attained. The Customer Enable bit (NR2(b0)) affects only the two B channels and the D channel. See BR0–BR3 and BR9 descriptions for a full description of the maintenance channel bits and their control.

6.11.2 Indication of Transmit States and Repeater Applications

BR8(b7:b4), Frame State 3 through Frame State 0, indicates the current state of the Superframe Framer. In a U–interface repeater it may be necessary to have the NT continue transmitting SN2 until the LT configured MC145572 receives SN3. Software must monitor the transmit state at least once every millisecond to determine when the NT starts transmitting SN2. When start of SN2 transmission is detected, write $A to BR8(b7:b4) to hold the transmit framer in SN2. Once The LT indicates full activation, the transmit framer can be allowed to proceed to SN3 by writing $0 to BR8(b7:b4).

It may also be necessary to disable the 15 second activation timer in repeater applications. This is done by setting Activation Timer Disable (BR11(b0)) to a 1 prior to initiating activation or when Activation in Progress, NR1 = $1 is detected.