RFL Electronics, Inc.

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IMUX 2000

DACS & ILS

CONFIGURATION PARAMETERS

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A. Introduction

DACS and ILS modules are configured by means of a set of parameters, stored in non-volatile memory of the DACS/ILS Processor. Configuration may be accomplished through the Network Management Software or by direct input to the processor module.

The initial configuration can be accomplished only at the local node of a system, since Network management cannot access other nodes until communication paths are functioning.

When using the direct method of parameter input through a CM3B unit controlling local node, the proper format of an SCL command is:

:[module]:set:[parameter]=[value];

where [module] is *dacs* or *ils*, as required, [parameter] and [value] are shown below.

For example, to turn AIS detection on some ILS unit off, use:

:ILS:SET:EAIS=OFF;

When communicating through a direct connection to the processor module, the [module] selection may be omitted and the whole command shortened to:

::set:[parameter]=[value];

Unless specifically mentioned, parameter values apply globally to all ports on the module.

As a troubleshooting hint, one should note that the performance of an ILS or DACS system depends also on the behavior of CM3B common modules located in the terminals and drop-and-inserts of the network. Parameters controlling the common modules should be carefully reviewed with regard to compatibility with DACS/ILS settings.

For example, most common interface problems stem from inappropriate encoding (B8ZS s. AMI) or framing (ESF vs. SF) settings on ports on both ends of a T1 link. Even though within a network there may be different configurations used (such as when a DACS is used to translate ESF-B8ZS to AMI-SF), on the same link both ports must be set identically.

Sometimes, inexplicable behavior of a system can be corrected by simply resetting the CM3B's to factory settings (from DIAG menu) and then re-entering any settings required for the particular application. This is due to the fact that even one wrong value in a rarely reviewed parameter can cause very subtle changes in performance, as opposed to an outright failure.

B. DACS Modules

1. General DACS Settings.

SRVC values: **ON , OFF** **DACS enable std operation of module**

This parameter allows selection of standard or non-standard initialization of the module.

When SRVC is set to ON, the DACS/ILS processor after initialization will check the status of T1 ports. If a port failure is indicated, the processor will switch the DACS or ILS module to a map/routing configuration appropriate for the first bad port detected. If another port indicates failure, no action will be taken until the first port recovers.

When SRVC is set to OFF, upon initialization the processor will set the DACS to map 0 and the ILS to normal routing. No action will be taken until all monitored ports recover fully.

A CM3B common module sets the SRVC parameter ON by default. Currently, whenever any configuration changes to DACS/ILS Processor are attempted through a CM3B, the SRVC parameter will be set to ON regardless of its previous state.

ACTx values: **ON , OFF** **DACS enable port monitoring**
where **x=[1..6]**

Parameter ACTx allows disabling of status monitoring of individual ports on a DACS module. Ports are always initialized and set according to current configuration.

When ACTx is set to OFF, status of port **x** is not monitored and no actions are taken upon communications failure. Front panel LED corresponding to port **x** is extinguished. Effectively, port **x** is ignored - both with regard to alarms and to switching of maps.
This situation is different from that created by setting LOSDLY,x=1000, in which the status of port **x** is still monitored, although no actions are taken upon failure.

When ACTx is set to ON, status of port **x** is monitored and appropriate actions are taken upon communications failure. LED corresponding to port **x** reflects port status. It is lit when no signal errors are detected and it is extinguished when errors are present - regardless whether map switching occurs (map switching will happen only if errors satisfy certain configurational and timing constraints).

CLOCK source values: [primary],[alternate] **DACS primary and alternate clock**

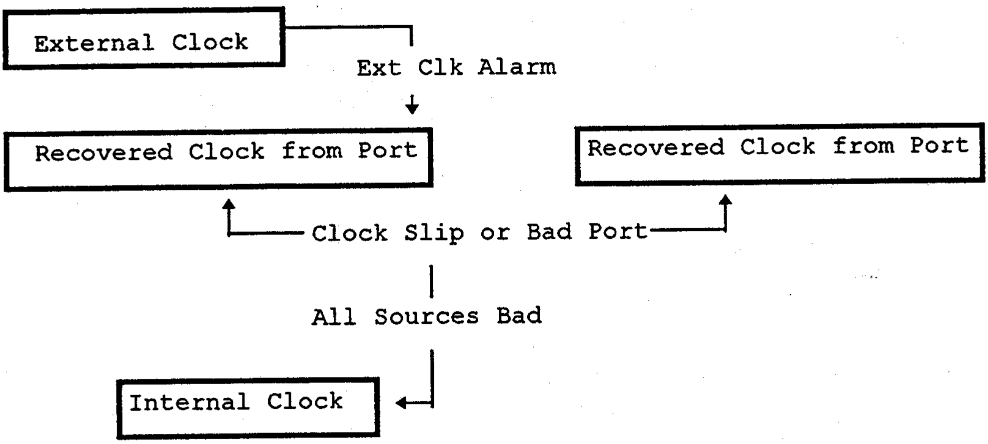
where **[primary]** or **[alternate] = [1..6], [M1..M6], INT, EXT, NONE**

The DACS module will use clock sources selected by CLOCK parameter to drive the internal DS0 grooming process and to serve as the T1 transmit clock. External clock and/or any of the 6 ports and/or the internal oscillator can serve as a clock source. Only up to 2 sources can be selected by this parameter.

External clock, if present and if enabled by CLOCK parameter, takes precedence over any other sources. Internal clock, even if not selected, will be used if all other clock sources are not available.

If a problem is detected at the current source of clock, DACS will use the alternate source. If the problem clears, DACS will not switch back unless there is a problem with the alternate.

If clock slippage is detected, the processor will switch between port sources specified in CLOCK parameter.



Clock source hierarchy.

The **M** qualifier is used to address the issue of loss of master timing node in the system by setting up a secondary master.

In the next node "downstream" after the master, the port facing the master should be denoted as **M**. For example, if port 1 in next node after master is facing the master, the following command may be issued:

```
node:dacs:set:clock=M1,4;
```

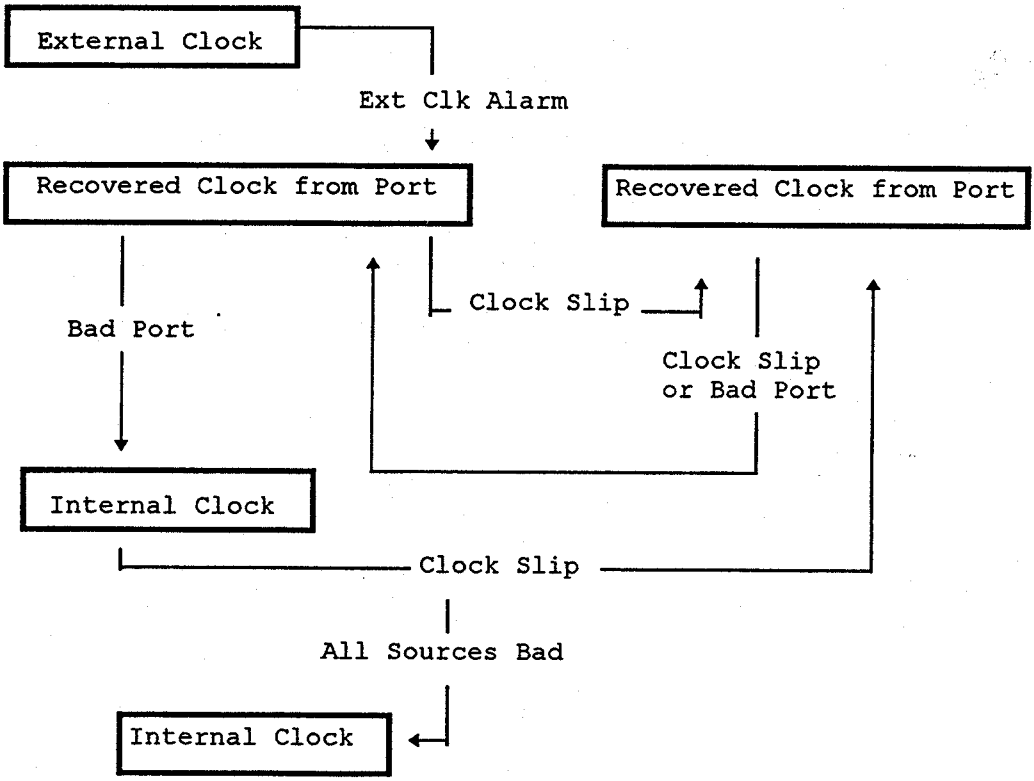
Such command results in following sequence of events:

If a problem is detected at port 1, the clock is first sourced from internal oscillator, regardless of what the other alternate source is. The processor will monitor the alternate source for clock slippage.

If no slip is present, the processor assumes that its own clock propagated through the system. This indicates that master node is lost. The processor will remain in internal timing, assuming the function of a secondary master, until clock slip occurs.

If clock slip occurs, then the processor knows that another source of timing is present in the system. DACS will switch to the alternate source specified in CLOCK parameter.

Note that only a port and only one port can be selected as **M**.



Clock source hierarchy for secondary master.

FTYPE,x values: **SF, ESF** **DACS framing type, ports 1 to 4**
where **x=[1..4]**

The FTYPE,x parameter is used to select superframe or extended superframe mode on specified port, 1 through 4.

FTYPx values: **SF, ESF** **DACS framing type, ports 5 and 6**
where **x=[5,6]**

The FTYPx parameter is used to select superframe or extended superframe mode on specified port, 5 or 6.

CODE,x values: **AMI, B8ZS** **DACS coding type, ports 1 through 4**
where **x=[1..4]**

The CODEx parameter is used to select AMI or B8ZS encoding mode on specified port, 1 through 4.

CODEx values: **AMI, B8ZS** **DACS coding type, ports 5 and 6**
where **x=[5,6]**

The CODEx parameter is used to select AMI or B8ZS encoding mode on specified port, 5 or 6.

2. Fault Detection - DACS.

Parameters listed below determine methods by which a DACS module determines the quality of communication paths attached to its ports.

ELOS values: **ON , OFF** **DACS enable Loss of Sync detection**

T1 transceiver ("framer") chips indicate loss of synchronization with incoming T1 stream via the LOS (Los Of Sync) flag. When ELOS is set to ON, appearance of this flag will cause the processor to assume a failure on the T1 port. After expiration of delays such as LOSDLY, the processor will take an appropriate action, such as switching of the maps.

When ELOS is set to OFF, the processor will ignore the state of the LOS flag.

Since LOS is based on the internal state of synchronization of a framer, it may appear delayed by several tens of milliseconds following an actual failure of communication path. Correspondingly, similar delays may occur when the paths are restored. Even more difficulties may be created by a brief disturbance of the path, since a framer could spend a long time re-synchronizing, again in the range of a few tens of milliseconds.

To prevent unnecessary switching of maps, it is imperative to apply a timing delay, LOSDLY. Only if the LOS flag persists longer than LOSDLY, can signal routing maps be switched. LOSDLY should be selected to be longer than any expected random losses of sync, caused by single spurious errors in communication paths. A suggested value for LOSDLY is 200ms in a non-Fast-Reframe system. A large number of nodes may require an increase in LOSDLY.

As mentioned above, LOS needs to be slowed down by LOSDLY to prevent misoperation of the system. In a system applications where fast switching is required, Fast Reframe should be used throughout the system. In such situation, ELOS should be set to OFF. The processor will rely on Fast Reframe Loss Of Frame (FLOF) to detect problems, which is a much faster and more reliable method.

ELOD values: **ON , OFF** **DACS enable Loss of Data detection**

T1 transceiver ("framer") chips indicate loss of data within incoming T1 stream via the RCL (Receive Carrier Loss) flag and the signal level via Receive Level bits. When ELOD is set to ON, appearance of the RCL flag or a drop of signal level below value set with LEVEL parameter will cause the processor to assume a failure on the T1 port. The processor will take appropriate action.

When ELOD is set to OFF, the processor will ignore both the state of the RCL flag and the level of signal.

EAIS values: **ON , OFF** **DACS enable EAIS detection**

Problems with communication paths are often indicated by presence of a "Blue Alarm" (referred to as All-Ones, or Alarm Indication Signal, AIS) at the port.

When EAIS is set to ON, appearance of AIS will cause the processor to assume a failure on the T1 port. The processor will take appropriate action.

When ELOS is set to OFF, the processor will ignore the state of AIS.

EBER values: **ON , OFF** **DACS enable BER detection**

Bit-Error-Rate may be used to indicate problems with communication paths. It is a slow alarm, however, since BER is updated by the framer chips only once a second.

When EBER is set to ON, values exceeding those set by **BER** parameter will cause the processor to assume a failure on the T1 port. The processor will take appropriate action.

When EBER is set to OFF, the processor will ignore the bit error rate.

EFLOF values: **ON , OFF** **DACS enable Fast Loss of Frame detect**

CM3B Common Modules independently monitor the quality of T1 communication paths. When a DACS or ILS unit works attached to a chassis containing CM3B's, the common modules can inform the DACS/ILS processor about any perceived problems.

When EFLOF is set to ON, alarm on the FLOF (Fast Loss of Frame) line from the common module will cause the processor to assume a failure on the T1 port. The processor will take appropriate action.

When EFLOF is set to OFF, the processor will ignore the FLOF line.

With Fast Reframe disabled, the FLOF signal from common module(s) represents the LOS (loss of sync) from the CM3B framer chip, and thus it somewhat duplicates the LOS signal generated locally at the DACS or ILS. The FLOF is less reliable, however, and thus switching on FLOF should be disabled when Fast Reframe is not used.

With Fast Reframe enabled on the common module, FLOF line represents the status of the Fast Reframe circuitry. It is extremely reliable and very fast and is very well suited to controlling DACS/ILS switching. When Fast Reframe is used, switching on FLOF should be enabled (EFLOF=ON) and switching on the less reliable local loss of sync should be disabled (ELOS=OFF).

3. DACS Failure Levels.

Parameters listed below determine at which level of disturbance the DACS/ILS processor decides that a fault occurred.

BER values: numeric **DACS Bit Error Rate switch level**

Bit-Error-Rate parameter sets the switch-on-error level. The entry format is nE-m, where n=[0..9] and m=[4..7]. This results in value range of 0 and 1E-7 to 9E-4.

When **EBER** (enable BER switching) is set to ON, error values exceeding those set by BER parameter will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action, such as switching of the maps.

When EBER is set to OFF, the processor will ignore bit error rate.

LEVEL values: numeric, dB **DACS signal strength switch level, dB**

The LEVEL parameter sets the minimum signal strength level, in decibels. If the incoming T1 signal falls below this level and **ELOD** (enable Loss-of-Data) is set to ON, the processor will assume a failure on the T1 port. The processor will take appropriate action.

LEVEL can be set to desired dB value by entering -7.5, -15 or NONE. If NONE is selected, signal strength is ignored.

When ELOD is set to OFF, the processor will ignore both signal strength and Received Carrier Level.

4. DACS Switch-on-Failure Timing.

Parameters listed below determine the delays involved in map switching following a port failure (healing process). Additionally, LOSDLY allows to disable map switching for a given port.

EFAST,x values: **ON** , **OFF** **DACS enable fast switching**
where **x=[1..4]**

After the processor determines that port **x** has failed (communication link broken) and if EFAST,x is set to OFF, no actions are taken for a period equal to switch delay **DLYx** or **LOSDLY,x** , depending on failure mode. After the delays pass, the processor will switch the DACS module to a map corresponding to the failed port.

If the EFAST,x parameter is set to ON, DLYx timers are bypassed for Loss of Data (LOD) and the processor switches maps and routings instantly (250us) after detecting port failure. Other failures (Fast Reframe Loss of Sync, Loss of Sync, etc.) are still buffered by their respective time delays.

DLYx values: numeric, msec **DACS error-to-switch delay, msec**
where **x=[1..4]**

After the processor determines that port **x** has failed, no actions are taken for a period equal to switch delay DLYx, in milliseconds. This pertains to failures detected by means of Carrier Loss and Level (as enabled by **ELOD** parameter), by means of Alarm Indication Signal (as enabled by **EAIS**), by means of BER (as enabled by **EBER**) or by means of Fast Loss of Frame (as enabled by **EFLOF** parameter). After the delay passes, the processor will switch the DACS module to a map corresponding to the failed port.

If the **EFAST** parameter is enabled, timer DLYx is bypassed for LOD errors and the processor switches maps and routings instantly (250us) after detecting port failure.

LOSDLY,x values: numeric, ms **DACS error-to-LOS indication delay, msec**
where **x=[1..4]** and value = **[0..995]**
LOSDLY,x values: numeric, ms **DACS map switch disable, port x**
where **x=[1..4]** and value = **1000**

After the processor determines that port **x** has failed by means of Loss of Sync (as enabled by **ELOS** parameter), no actions are taken for a period equal to switch delay LOSDLY,x, in milliseconds. After the delay passes, the processor will switch the DACS module to a map corresponding to the failed port. Any value between 0 and 999 may be entered for the delay, but the processor will round it down to nearest increment of 5.

Setting LOSDLY,x to 1000 disables switching of maps based failure of port **x**. The status of the port will be still monitored and displayed via front panel LED's. Typically, this is used for a port connected to the backup path, to prevent a switch of maps due to bad backup.

This is different from setting ACTx to OFF, which disables both monitoring port and switching of maps.

5. DACS Switch-on-Recovery Timing

Parameters listed below determine the delays involved in map and routing switching following a port recovery.

REC values: numeric, sec **DACS recovery delay, sec**

After the processor determines that a failed port is recovered (communication link restored), no actions are taken for a period equal to the recovery delay, in seconds. After the recovery delay passes, the processor will switch the DACS module back to map 0.

The recovery delay allows the system to settle following the restoration of primary links before attempting to switch to the primaries. The larger and more complex the system, the more delay is required.

REC can be set between .5s and 2.5s in .5s increments.

6. Recommended Settings of DACS parameters.

Table below indicates recommended settings of DACS parameters, in order in which they appear as a result of the **::config?:flags_;** statements.

Column **Fast** pertains to a system utilizing Fast Reframe, **No Fast** to a system without this feature. Asterisks denote differences between both arrangements.

DLY value of 1ms has been determined to be sufficient for systems including up to 4 nodes. Each additional node requires an approximate increase of 0.5ms. Actual measurements should be performed to confirm this setting.

	Fast		No Fast	
ELOS	OFF	*	ON	Switch on framer LOS
ELOD	ON		ON	Switch on framer Carrier Loss + Level
EAIS	ON		ON	Switch on AIS
EBER	OFF		OFF	Switch on BER
EFLOF	ON	*	OFF	Switch on CM3B LOS / FRLOS
ACT1	ON		ON	DACS port enable
ACT2	ON		ON	DACS port enable
ACT3	ON		ON	DACS port enable
ACT4	ON		ON	DACS port enable
ACT5	ON		ON	DACS port enable
ACT6	ON		ON	DACS port enable
REC	2.0		2.0	Recover dly, signal-to-switch, sec
BER	1.E-05		1.E-05	BER switch level
DLY1	1		1	DACS error-to-switch delay, port 1, msec
DLY2	100		100	DACS error-to-switch delay, port 2, msec
DLY3	100		100	DACS error-to-switch delay, port 3, msec
DLY4	1		1	DACS error-to-switch delay, port 4, msec
CLOCK	5,INT		5,INT	DACS primary & alternate clock
LEVEL	-7.5dB		-7.5dB	Level switching point (via ELOD)
FTYP5	ESF		ESF	DACS port 5 framing type SF/ESF
CODE5	B8ZS		B8ZS	DACS port 5 coding AMI/B8ZS
FTYP6	ESF		ESF	DACS port 6 framing type SF/ESF
CODE6	B8ZS		B8ZS	DACS port 6 coding AMI/B8ZS
FTYPE,1	ESF		ESF	DACS port 1 framing SF/ESF
CODE,1	B8ZS		B8ZS	DACS port 1 coding AMI/B8ZS
EFAST,1	ON	*	OFF	DACS fast switch port 1 (bypasses DLY1)
LOSDLY,1	85	*	300	DACS port 1 LOS-to-switch dly, msec
FTYPE,2	ESF		ESF	DACS port 2 framing SF/ESF
CODE,2	B8ZS		B8ZS	DACS port 2 coding AMI/B8ZS
EFAST,2	OFF		OFF	DACS fast switch port 2 (bypasses DLY2)
LOSDLY,2	85	*	300	DACS port 2 LOS-to-switch dly, msec
FTYPE,3	ESF		ESF	DACS port 3 framing SF/ESF
CODE,2	B8ZS		B8ZS	DACS port 3 coding AMI/B8ZS

EFAST,3	OFF		OFF	DACS fast switch port 3 (bypasses DLY3)
LOSDLY,2	85	*	300	DACS port 3 LOS-to-switch dly, msec
FTYPE,4	ESF		ESF	DACS port 4 framing SF/ESF
CODE,4	B8ZS		B8ZS	DACS port 4 coding AMI/B8ZS
EFAST,4	ON	*	OFF	DACS fast switch port 4 (bypasses DLY4)
LOSDLY,4	85	*	300	DACS port 4 LOS-to-switch dly, msec

Figure 1.
DACS parameter setting chart.

c. ILS Modules

1. General ILS Settings

SRVC values: **ON , OFF** **ILS enable std operation of module**

This parameter allows selection of standard or non-standard initialization of module.

When SRVC is set to ON, the DACS/ILS processor after initialization will check the status of T1 ports. If a port failure is indicated, the processor will switch the ILS module to a routing configuration appropriate for the first bad port detected. If another port indicates failure, no action will be taken until the first port recovers.

When SRVC is set to OFF, upon initialization the processor will set the ILS to normal routing. No action will be taken until all monitored ports recover fully.

A CM3B common module sets the SRVC parameter ON by default. Currently, whenever any configuration changes to DACS/ILS processor are attempted through a CM3B, the SRVC parameter will be set to ON regardless of its previous state.

USEx values: **ON , OFF** **ILS enable port monitoring**
where **x=[1] or [4]**

Parameter USEx allows disabling of status monitoring of individual primary ports on an ILS module. Ports are always initialized and set according to current configuration.

When USEx is set to OFF, status of port **x** is not monitored and no actions are taken upon communications failure. Front panel LED corresponding to port **x** is extinguished.

When USEx is set to ON, status of port **x** is monitored and appropriate actions are taken upon communications failure. LED corresponding to port **x** reflects port status. It is lit when no signal errors are detected and it is extinguished when errors are present - regardless whether routing switching occurs (route switching will happen only if errors satisfy certain configurational and timing constraints).

EXCLK values: **ON, OFF** **ILS external clock enable**

If a good external clock is present, it will be used as the clock source for an ILS module if EXCLK is set to ON.

Setting of EXCLK parameter to OFF prevents external clock from being utilized. Instead, recovered clock is used for retransmission of data.

Using external clock in an ILS should be attempted only in special situations. Typically, recovered clock is recommended since an ILS has limited provisions for buffering of clock and data. Refer to DACS/ILS Application Note 04, *ILS Signal Routing Principles* for more details.

FTYPE values: **SF, ESF** **ILS framing type**

The FTYPE parameter is used to select superframe or extended superframe mode on all ports.

CODE values: **AMI, B8ZS** **ILS coding type**

The CODE parameter is used to select AMI or B8ZS encoding mode on all ports.

MODE values: **MASTER, SLAVE, HOT** **ILS mode select**

In a system consisting of only two nodes, both of which utilize an ILS module, there is no source of timing to drive backup ports while normal (primary) paths are used. In such system, one ILS module must be designated as MASTER, the other as SLAVE.

A slave node retransmits into a backup path all received data and timing. A master node transmits timing derived from local ports (i.e., 5 and 6) into backup ports 2 and 3. Also, idle data and forced FDL is driven into the backup paths, thus effectively "priming" the unused paths with good framing and FDL.

In a system consisting of more than 2 nodes, at least one DACS must be used. This is required in order to absorb difference between path lengths and multiples of frame times, which would otherwise cause continuous loss of framing. (See discussion of HEAL parameter). ILS modules use no internal buffers and thus have no way of absorbing any time delays.

In such system, the DACS serves as a master and therefore all ILS modules should be set as SLAVE.

A system configuration utilizing only 2 paths between nodes (i.e., connected either to ports 1 and 2 or to ports 4 and 3) is known as Hot Standby. In such system, the ILS modules must be set as HOT. This setting allows T1 timing and data to be continuously driven onto both the primary and the backup path.

2. ILS Fault Detection

Parameters listed below determine methods by which a DACS module determines the quality of communication paths attached to its ports..

ELOS values: **ON , OFF** **ILS enable Loss of Sync detection**

T1 transceiver ("framer") chips indicate loss of synchronization with incoming T1 stream via the LOS (Los Of Sync) flag. When ELOS is set to ON, appearance of this flag will cause the processor to assume a failure on the T1 port. After expiration of delays such as LOSDLY, the processor will take an appropriate action, such as switching of the maps.

When ELOS is set to OFF, the processor will ignore the state of the LOS flag.

Since LOS is based on the internal state of synchronization of a framer, it may appear delayed by several tens of milliseconds following an actual failure of communication path. Correspondingly, similar delays may occur when the paths are restored. Even more difficulties may be created by a brief disturbance of the path, since a framer could spend a long time re-synchronizing, again in the range of a few tens of milliseconds.

To prevent unnecessary switching of maps, it is imperative to apply a timing delay, LOSDLY. Only if the LOS flag persists longer than LOSDLY, can signal routing maps be switched. LOSDLY should be selected to be longer than any expected random losses of sync, caused by single spurious errors in communication paths. A suggested value for LOSDLY is 200ms in a non-Fast-Reframe system. It may require an increase for large number of nodes in a system.

As mentioned above, LOS needs to be slowed down by LOSDLY to prevent misoperation of the system. In a system applications where fast switching is required, Fast Reframe should be used throughout the system. In such situation, ELOS should be set to OFF. The processor will rely on Fast Reframe Loss Of Frame (FLOF) to detect problems, which is a much faster and more reliable method.

ELOD values: **ON , OFF** **ILS enable Loss of Data detection**

T1 transceiver ("framer") chips indicate loss of data within incoming T1 stream via the RCL (Receive Carrier Loss) flag and the signal level via Receive Level bits. When ELOD is set to ON, appearance of RCL flag or drop of level below value set with LEVEL parameter will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action.

When ELOD is set to OFF, the processor will ignore both the state of the RCL flag and the level of signal.

EAIS values: **ON** , **OFF** **ILS enable EAIS detection**

Problems with communication path are often indicated by presence of "Blue Alarm" (referred to as All-Ones, or Alarm Indication Signal, AIS) at the port.

When EAIS is set to ON, appearance of AIS will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action.

When ELOS is set to OFF, the processor will ignore the state of AIS.

EBER values: **ON** , **OFF** **ILS enable BER detection**

Bit-Error-Rate may be used to indicate problems with communication paths. It is a slow alarm, however, since BER is updated by the framer chips only once a second.

When EBER is set to ON, values exceeding those set by **BER** parameter will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action.

When EBER is set to OFF, the processor will ignore the bit error rate.

EFLOF values: **ON** , **OFF** **ILS enable Fast Loss of Frame detect**

CM3B Common Modules independently monitor the quality of T1 communication paths. When a DACS or ILS unit works attached to a terminal chassis containing CM3B's, the common modules can inform the DACS/ILS processor about any perceived problems.

When EFLOF is set to ON, alarm on FLOF (Fast Loss of frame) line from the common module will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action.

When EFLOF is set to OFF, the processor will ignore the FLOF line.

With Fast Reframe disabled, the FLOF signal from common module(s) represents the LOS (loss of sync) from the CM3B framer chip, and thus it somewhat duplicates the LOS signal generated locally at the DACS or ILS. The FLOF is less reliable, however, and thus switching on FLOF should be disabled when Fast Reframe is not used.

With Fast Reframe enabled on common module, FLOF line represents the status of the Fast Reframe circuitry. It is extremely reliable and very fast and is very well suited to controlling of DACS/ILS switching. When Fast Reframe is used, switching on FLOF should be enabled (EFLOF=ON) and switching on the less reliable local loss of sync should be disabled (ELOS=OFF).

3. ILS Failure Levels

Parameters listed below determine at which level of disturbance the DACS/ILS Processor decides that a fault occurred.

BER values: numeric **ILS Bit Error Rate switch level**

Bit-Error-Rate parameter sets the switch-on-error level. The entry format is nE-m, where n=[0..9] and m=[4..7]. This results in value range of 0 and 1E-7 to 9E-4.

When **EBER** (enable BER switching) is set to ON, error values exceeding those set by BER parameter will cause the processor to assume a failure on the T1 port. The processor will take an appropriate action, such as switching of signal routings.

When EBER is set to OFF, processor will ignore bit error rate.

LEVEL values: numeric, dB **ILS signal strength switch level, dB**

The LEVEL parameter sets the minimum signal strength level, in decibels. If the incoming T1 signal falls below this level and **ELOD** (enable Loss-of-Data) is set to ON, the processor will assume a failure on the T1 port. . The processor will take appropriate action.

LEVEL can be set to desired dB value by entering -7.5, -15 or NONE. If NONE is selected, signal strength is ignored.

4. ILS Switch-on-Failure Timing.

Parameters listed below determine the delays involved in map and routing switching following a port failure (healing process).

EFAST values: **ON** , **OFF** **ILS enable fast switching**

After the processor determines that port **x** has failed (communication link broken) and if EFAST is set to OFF, no actions are taken for a periods equal to switch delays **DELAY** and **LOSDLY** , in milliseconds. After the delays pass, the processor will switch an ILS module to a routing appropriate for the failed port.

If the EFAST parameter is set to ON, DELAY value is bypassed for Loss of Data (LOD) and the processor switches maps and routings instantly (250us) after detecting port failure. Other failures (Fast Reframe Loss of Sync, Loss of Sync, etc.) are still buffered by their respective time delays.

DELAY values: numeric, msec **ILS error-to-switch delay, msec**

After the processor determines that a port has failed, no actions are taken for a period equal to switch delay DELAY, in milliseconds. This pertains to failures detected by means of Carrier Loss and Level (as enabled by **ELOD** parameter), by means of Alarm Indication Signal (as enabled by **EAIS**), by means of BER (as enabled by **EBER**) or by means of Fast Loss of Frame (as enabled by **EFLOF** parameter). After the delay passes, the processor will switch the ILS module to a routing appropriate for the failed port.

If the **EFAST** parameter is enabled, DELAY is bypassed for LOD errors and the processor switches maps and routings instantly (250us) after detecting port failure.

LOSDLY values: numeric, msec **ILS LOS-to-switch delay, msec**

After the processor determines that a port has failed by means of Loss of Sync (as enabled by **ELOS** parameter), no actions are taken for a period equal to switch delay LOSDLY, in milliseconds. After the delay passes, the processor will switch the ILS module to a routing appropriate for the failed port.

5. ILS Switch-on-Recovery Timing.

Parameters listed below determine the delays involved in map and routing switching following a port recovery.

REC values: numeric, sec **ILS recovery delay, sec**

After the processor determines that a failed port is recovered (communication link restored), no actions are taken for a period equal to the recovery delay, in seconds. After the recovery delay passes, the processor will switch an ILS module to normal routing.

REC values: numeric, sec **ILS recovery delay, sec**

After the processor determines that a failed port is recovered (communication link restored), no actions are taken for a period equal to the recovery delay, in seconds. After the recovery delay passes, the processor will switch the ILS module back to primary routing.

The recovery delay allows the system to settle following the restoration of primary links before attempting to switch to the primaries. The larger and more complex the system, the more delay is required.

REC can be set between .5s and 2.5s in .5s increments.

6. Reverting on Loss of Master

Parameters listed below are involved when a master node is lost, resulting in an ILS-only network. These are internal, hard-coded values, not accessible to the user. They are described here for reference only.

HEAL hardcoded numeric, **300ms** **ILS healing check delay, msec**

The HEAL parameter addresses the issue of loss of a master node in a network consisting of ILS modules. When the remaining network consists of only slave ILS nodes, a ring topology cannot be maintained. Slave-only ring operation would result in constant framing errors due to lack of buffering on ILS.

Each ILS and each data path has a fixed propagation delay. All these delays add up to a closed-circuit delay around the ring, which is unlikely to be a multiple of a frame length. As a frame travels around the ring, it will have to be periodically cut and re-aligned to fit into the closed-circuit time.

To allow continuing operation of the remaining section of the ring, at least one of the ILS modules must fall back into primary configuration, thus breaking the ring open into a linear topology which can handle the fixed data propagation delay through the ILS modules.

Each ILS unit, after switching into a backup mode following port failure, waits for a time determined by HEAL parameter and then checks whether the system is operational. If the communication path was healed properly, Loss-of-Sync flag should be reset or appear very infrequently.

However, if an ILS-only ring was created due to loss of a master, a series of LOS pulses should be present as the framer chips continuously re-align themselves. If density of these pulses exceeds the value set by **RATIO** parameter, the processor assumes that a master is lost and therefore reverts back to normal routing. The ILS will then remain in normal routing configuration until all ports recover fully. At that point, the processor will again monitor ports for signs of failure and switch routing accordingly.

RATIO hardcoded numeric, **15%** **ILS alarm-level ratio of LOS pulses**

The RATIO parameter is used while determining whether loss of a master node resulted in an slave-ILS-only ring network (see description of **HEAL** parameter).

If such network is created, Loss-of-Sync (LOS) appears as a train of pulses. RATIO sets a limit level for density (duty cycle) of these pulses. If LOS pulses appear more frequently than the RATIO percentage, the processor assumes that a master is lost and therefore reverts back to normal routing. The ILS will then remain in normal routing configuration until all ports recover fully. At that point, the processor will again monitor ports for signs of failure and switch routing accordingly.

7. Recommended Settings of ILS parameters.

Table below indicates recommended settings of ILS parameters, in order in which they appear as a result of the **::config?:flags_;** statements.

Column **Fast** pertains to a system utilizing Fast Reframe, **No Fast** to a system without this feature. Asterisks denote differences between both arrangements.

DELAY value of 1ms has been determined to be sufficient for systems including up to 4 nodes. Each additional node requires an increase of 0.5ms. Actual measurements should be taken to confirm this setting.

	Fast		No Fast	
ELOS	OFF	*	ON	Switch on framer LOS
ELOD	ON		ON	Switch on framer Carrier Loss + Level
EAIS	ON		ON	Switch on AIS
EBER	OFF		OFF	Switch on BER
EFLOF	ON	*	OFF	Switch on CM3B LOS / FRLOS
FTYPE	ESF		ESF	ILS framing type SF/ESF
MODE	SLAVE		SLAVE	ILS master/slave mode
USE1	ON		ON	ILS port enable
USE4	ON		ON	ILS port enable
EXCLK	OFF		OFF	ILS external clock enable
CODE	B8ZS		B8ZS	ILS coding AMI/B8ZS
BER	1.E-05		1.E-05	BER switch level
LEVEL	-7.5dB		-7.5dB	Level switching point (via ELOD)
EFAST	ON	*	OFF	ILS fast switch, all ports (bypasses DELAY)
DELAY	1		1	ILS error-to-switch delay, all ports, msec
REC	1.0		1.0	Recover dly, signal-to-switch, sec
LOSDLY	85	*	200	ILS LOS-to-switch debounce delay, msec

Figure 2.
ILS parameter setting chart.

Appendix A.

DACS and ILS switch triggering

DACS/ILS Processor monitors T1 communication lines connected to ports of DACS or ILS modules. If the signal reaching a port is deemed to be deficient, appropriate actions are taken, for example resulting in switching of DACS maps or ILS routings.

The determination of quality of T1 signal is based on the following parameters:

- **LOS** - Loss of Sync alert generated by the framer chip.
- **LOD** - Loss of Data, a composite alert, consisting of Received Carrier Loss generated by the framer chip or by Receive Level indication, which is below value set by LEVEL parameter.
- **AIS** - Alarm Indication Signal generated by the framer, indicating reception of Blue Alarm (unframed all-ones).
- **BER** - Bit Error Rate alert, set when the errors indicated by framer chip exceed level set by BER parameter.
- **FLOF** - Fast Reframe Loss of Frame alert, set when the CM3B Common Module attached to DACS or ILS detects framing problems. When in fast reframe mode, CM3B indicates loss of fast reframe synchronization. When not in fast reframe, CM3B forwards the Loss of Sync signal from its framer.

All these characteristics are checked independently for each of framers on ports 1 through 4. When a problem is detected, the green front panel LED indicator corresponding to the affected port is extinguished.

The DACS/ILS Processor will take further action only if enabled by the appropriate **E...** parameter (ELOS, ELOD, etc.) and only after certain time delays. LOS (Loss of Sync) is timed by the LOSDLY timer. All other failures are timed by the DLY timer for DACS and by the DELAY timer for ILS.

If EFAST (Enable FAST switching) is set, LOD (Loss of Data) needs not to be present for the whole DLY/DELAY time period. Instead, switching action will be taken if LOD is present for 2 consecutive polls, typically 125us apart.

The actual action taken by the processor depends on type of module it controls. In a DACS, the processor will activate a map corresponding to the failed port. In an ILS, failure of a primary port will cause signal routing to be switched to the backup port if it is operational. Refer to Application Note 04, *"ILS Signal Routing Principles"* for more details.

A representation of the switching logic is shown in Figure 3. Switch symbols denote enabling function. Summing nodes require that at least one of involved conditions is present.

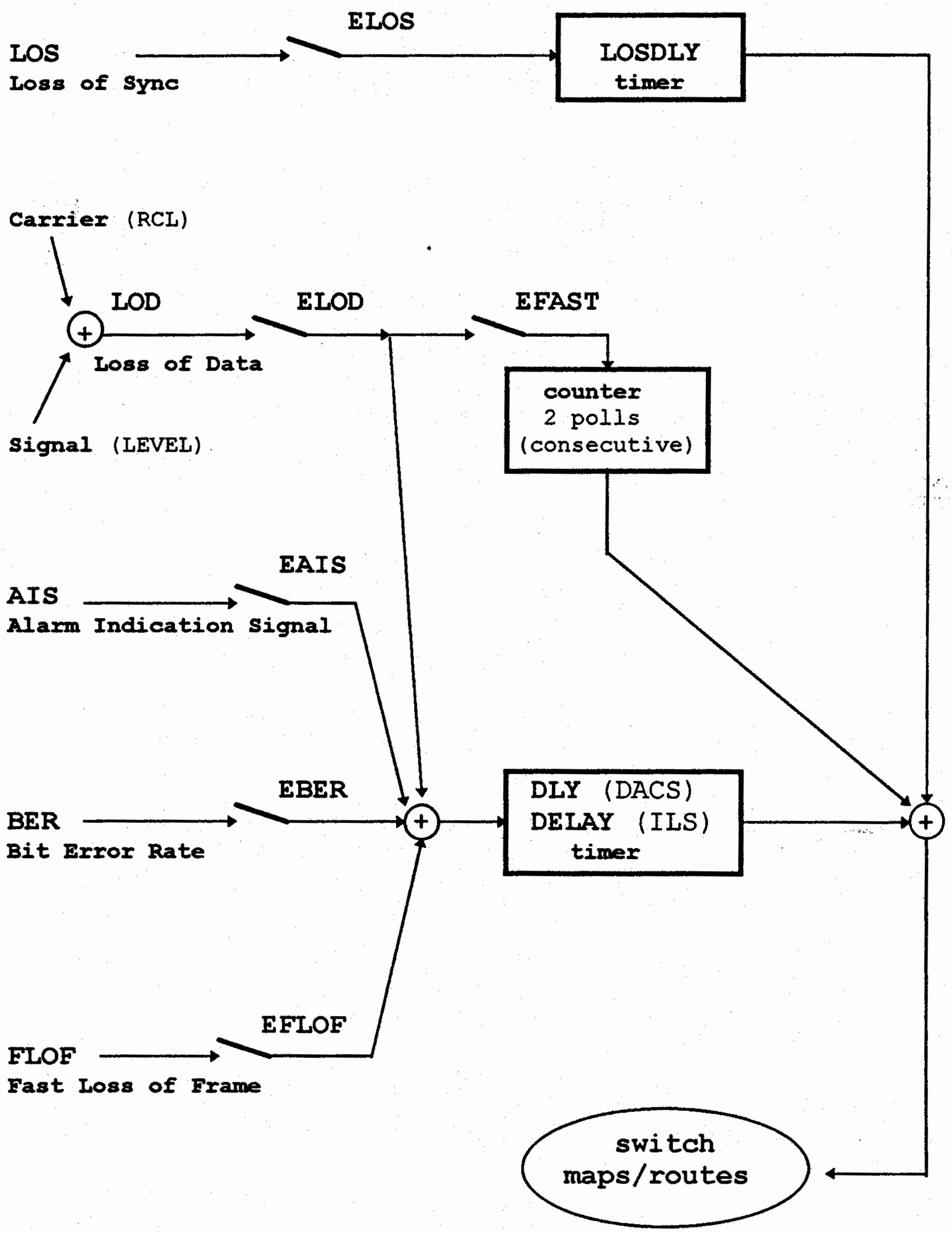


Figure 3.

Triggers of DACS and ILS switching..