Product summary
Ultrastar 36XP
FC-AL

Model: DRHL-36L

Introducing

IBM offers the Ultrastar 36XP Fibre Channel drive with a capacity 36.4 GB. With advanced disk drive technologies such as S.M.A.R.T., No-ID sector formatting, the Drive Temperature Indicator (Drive-TIP) feature, and a programmable, multi-segmented 2.0 MB cache, the 36XP provides outstanding performance and reliability with superior storage capacity.

Applications

- Technical/commercial workstations
- Network servers
- High-end personal computers
- Video editing
- Multimedia
- Data mining applications

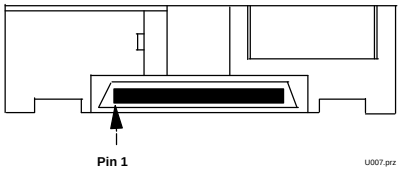
Features	Benefits
• 36.4 GB formatted capacity	• Superior storage capacity
• Dual 1.06 Gb/s Fibre Channel Arbitrated Loop	• Fast interface data rate: 200 MB/sec
• 11.7 - 19.9 MB/sec sustained data transfer rate • 17.7 - 28.9 peak media transfer rate	• High data rate across entire disk surface
• Average seek time 7.5 ms (typical read) • Latency 4.17 ms	• Fast access to data
• 4 MB programmable multi-segmented cache buffer	• Fast data retrieval in single and multitasking applications
• Low command overhead • ECC on the fly (EOTF)	• Improved data throughput
• Magneto resistive Extended Head technology	• High areal density
• No-ID sector formatting • PRML data channel	• More data stored per track, increased sustained data transfer rate
• Predictive Failure Analysis (S.M.A.R.T. compliant) • Drive Temperature Indicator Processor (Drive-TIP) feature	• High reliability and availability

ATTENTION: The drive must be protected against electrostatic discharge especially when being handled. The safest way to avoid damage is to put the drive in an antistatic bag before an ESD wrist strap is removed.

Drives should only be shipped in approved containers. Severe damage can be caused to the drive if the packaging does not adequately protect against the shock levels induced when a box is dropped. Consult your IBM representative if you do not have an approved shipping container.

FC-AL electrical connector

The electrical connector is located as shown.



40-Pin SCA-2 SFF-8045 FC-AL connector definition

The Ultrastar 9LZX and 18ZX use the 40 pin SCA-2 connector defined by the ANSI SFF-8045 specification. The SFF-8067 specification is also supported. The connector allows for plugging a drive directly into a back plane by providing the necessary electrical connections. Mechanical stability and device retention must be provided by other mechanisms outside the drive. There are many signals defining the 40 pin connector and several definitions are included in the following text.

Signal Name	Connector Contact Number		Signal Name
-ENBL BYP CH1	**1**	**21**	12 V dc Charge
12 Volts dc	**2**	**22**	12 V dc Ground
12 Volts dc	**3**	**23**	12 V dc Ground
12 Volts dc	**4**	**24**	+Port 1_In
-Parallel ESI	**5***	**25**	-Port 1_In
-Drive Present	**6**	**26**	12 V dc Ground
Ready LED Out	**7**	**27**	+Port 2_In
Spindle Sync	**8**	**28**	-Port 2_In
Start_1/Mated	**9**	**29**	12 V dc Ground
Start_2/Mated	**10**	**30**	+Port 1_Out
-ENBL BYP CH2	**11**	**31**	-Port 1_Out
Sel_6/ -EFW	**12***	**32**	5 V/3.3 V dc Ground
Sel_5/ -P_ESI_5	**13***	**33**	+Port 2_Out
Sel_4/ -P_ESI_4	**14***	**34**	-Port 2_Out
Sel_3/ -P_ESI_3	**15***	**35**	5V/3.3V dc Ground
Fault LED Out	**16**	**36***	Sel_2/ -P_ESI_2
OPT 3.3 Volts dc	**17**	**37***	Sel_1/ -P_ESI_
OPT 3.3 Volts dc	**18**	**38***	Sel_0/ -P_ESI_0
5 Volts dc	**19**	**39**	OPT 3.3 V dc Charge
5 Volts dc	**20**	**40**	5 V dc Charge

Notes: The 3.3 V contacts are not connected in the drive. The Guide Pins are connected to 5 V/3.3 V ground.
*The definition changes for the ANSI SFF-8067 40-pin SCA-2 connector. Refer to the Ultrastar 9LZX & 18ZX FC-AL hardware/functional specifications for the details.

Voltage and ground signals
The +12 V dc and +5 V dc voltage contacts provide all of the voltages required by the drive. The two voltages share a common ground plane to which all of the ground contacts are connected. The 3.3 V dc contacts are left open.

Spindle sync
Spindle sync (connector pin 8) is not supported by this drive.

Fault LED out
The Fault LED is driven by the following conditions:

- both enable bypass signals are asserted by the drive
- an internal failure has been detected by the drive
- the drive has been instructed by the host to turn on the LED

The drive provides an open-collector transistor-transistor logic (TTL) driver with up to 30 mA of current sink capability to the drive Fault LED. The cathode of the LED is connected to this signal. The LED and the current-limiting resistor must be provided by the enclosure.

Ready LED out
The Ready LED has the following indications (per the Hot Plug implementation):

- *Drive not mated:* The signal is de-asserted, that is, high. The LED is off.
- *Drive mated, motor not spinning:* The LED is generally off. The LED is turned on long enough to be seen by an observer whenever a SCSI command is received.
- *Drive mated, spinning up or spinning down:* The LED is flashing with an equal on and off period of 1/2 second.
- *Drive mated, motor spinning:* The signal is normally on continuously. Whenever a SCSI command is received, the signal is off long enough to be seen by an observer.

The drive provides an open-collector TTL driver with up to 30 mA of current sink capability to drive the Ready LED. The cathode of the LED is connected to this signal. The LED and the current-limiting resistor must be provided by the enclosure.

Start_X/Mated controls (pins 9 and 10)
These two signals are TTL inputs to the drive and have associated 10 KOhm resistors. The following table shows the logic combinations and motor spin functions that can be created.

Start_2 Mated	Start_1 Mated	Motor spin function
Open	Open	Drive is not mated. No spin-up will occur.
Open	GND	The motor will spin up with the SCSI Unit Start Command.
GND	Open	The motor will spin up after a delay of 12 times the modulo 8 value of Sel_ID (in seconds).
GND	GND	The motor will spin up after drive initialization.

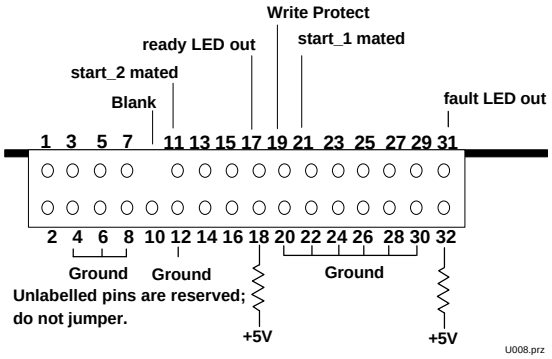
SEL_n and enclosure service signals
These signals have different definitions depending on the state of **-Parallel ESI** (pin 5) and the level of enclosure service supported by the back plane. When **-Parallel ESI** is de-asserted (high), the back plane must present SEL_ID information on these signals (within 1 us). When **-Parallel ESI** is asserted (low), the back plane (if supported) will present enclosure service information on these signals (within 1 us). The drive will then go through a discovery phase to determine the level of enclosure services that the back plane supports (for example; none, SFF-8045, or SFF-8067) and behave accordingly. Seven signals define 128 possible values and are directly translated into an Arbitrated Loop Physical Address (AL-PA). The drive will attempt to acquire the data for its own during part of the loop initialization process of the drive.

-ENBL BYP CH1, -EnBL BYP CH2
These TTL outputs from the drive provide up to 4 mA of sink current. The outputs are intended to control the state of a loop port bypass circuit on the back plane. The drive powers up with these signals turned off. The back plane must provide a 10 KOhm pull-up resistor that will ensure that the drive is bypassed on the loop when it is not present or when it is powering up. After a successful power-up, the drive will attempt to enable itself on both loops (if allowed to do so via SCSI mode page 0x19). These signals are also controllable by the host with the LPB and LPE Fibre Channel primitives command sequence.

-Drive Present
This signal is connected to the drive's ground plane. The back plane can use this signal to detect the presence of a drive.

Front option jumper block

Jumper position and function are shown below.



This drive model contains a *Front Option Jumper Block* that can be used to enable optional features. The jumper block provides some useful features not available in SFF-8045, and also provides an alternate means of options access.

The Option Block connector (2x16) is an AMP connector (PN 84156-5) with a pin spacing of 2 mm.

Data organization

Number of disks	10
Number of heads	20

Seek times (in milliseconds)

Single cylinder	Read	0.3
	Write	0.9
Average (weighted)	Read	7.5
	Write	8.5
Full stroke (typical)	Read	14.5
	Write	15.7

User capacities for several block lengths

512	36,954,401,790
514	36,804,921,684
520	36,434,947,120
522	36,492,490,692
524	36,521,964,744
528	36,556,040,928
536	36,522,582,256
688	37,791,706,528
732	38,184,550,152

DC power requirement limits

The following voltage specifications apply at the drive power connector. There is no special power on/off sequencing required.

Power supply current

	Pop. mean (A)	Pop. max. (A)
+5VDC (Power Save mode[1])	0.55 [2]	
+5VDC (Idle)	0.77	
+5VDC (R/W baseline)	0.93	
+5VDC (R/W pulse)		1.32
+12VDC (Power Save mode)	0.72	
+12VDC (Idle)	0.71	
+12VDC (Seek Peak)		2.3
+12VDC (Start)		2.60 [3]

Notes:

[1] *Power save mode is automatically invoked after 1 second of inactivity, except when read ahead is active, in which case power save mode is invoked after 40 seconds of inactivity.*

[2] *+5 V current is given with termination power provided by the using system if required.*

[3] *The start current is the total +12 V current required by the drive.*

Generated ripple at drive power connector

V dc	Maximum (mV p-p)	Frequency
+5	250	0-20 MHz
+12	650	0-100 Hz
+12	400	100-5,000 Hz
+12	250	5 KHz-20 MHz

During drive start up and seeking, 12 volt ripple is generated by the drive (referred to as dynamic loading). If several drives have their power supply daisy chained together, the power supply ripple plus other drives' dynamic loading must remain within the regulation tolerance window of +/- 5%. A common supply with separate power leads to each drive is a more desirable method of power distribution.

Hot Plug/Unplug support

The term “Hot Plug” refers to the action of mechanically engaging a device to power and/or SCSI bus when other devices may be active on the same bus.

During Hot Plug events the non-operational shock levels should not be exceeded. The operational shock levels of adjacent drives should also not be exceeded. The recommended procedure is to prohibit write operations to adjacent drives during the Hot Plug and during the Hot Unplug actions. During Hot Unplug the operational shock limit specifications should not be exceeded. If this cannot be guaranteed then the drive should be issued a SCSI Stop Unit command that is allowed to complete before unplugging. The recommended procedure is to allow the unplugged drive to rest in the drive bay for a minimum of 15 seconds and then complete the removal.

During Hot Plug or Unplug events the power supply ripple on adjacent operational drives should not go outside of the +/-5% regulation tolerance.

Operating environment

The drive operates within its performance limits when the following environment is maintained.

Operating conditions

Temperature	5 to 50°C ambient 5 to 65°C disk enclosure
Temperature gradient	20°C per hour
Humidity	5% to 90% (time-average)
Wet Bulb Temperature	26.7°C maximum
Elevation	-304.8 to 3048 meters

Nonoperating conditions

Temperature	1 to 65°C storage -40 to 65°C shipping
Temperature gradient	below condensation
Humidity	5% to 90% (time-average) storage 5% to 95% (applies at packaged level) shipping
Wet Bulb temperature	29.4°C maximum
Elevation	-304.8 to 12,192 m shipping -304.8 to 3048 m storage

Start and stop times

Bring-up sequence times (seconds)

	Nominal	Worst Case
Power-Up	2.5	3
Start attempts	0	4.6
Spin-Up	10.5	14
Servo Recal	9.9	9.5
Bats2/Reassign	0.5	1
Startup Time	20.9	29.1

Note: Worst Case represents a 3-sigma event.

Bring-up sequence times and stop times

See the illustration on this page.

Note: If a SCSI Reset is issued while the drive is in either a Power-Up or Startup sequence, that same sequence starts again. In all with HTML training other cases when a SCSI Reset is issued the present state of the motor is not altered.

Note: A startup sequence initiated by a SCSI “Start/Stop Unit” command that follows a spindle stop initiated by a SCSI “Start/Stop Unit” command by less than 10 seconds may result in the startup sequence increasing by as much as 10 seconds. For example, if a delay of only 3 seconds exists between the two commands the second command takes 7 seconds longer than if 10 seconds or more had been allowed between the commands.

Vibration and shock

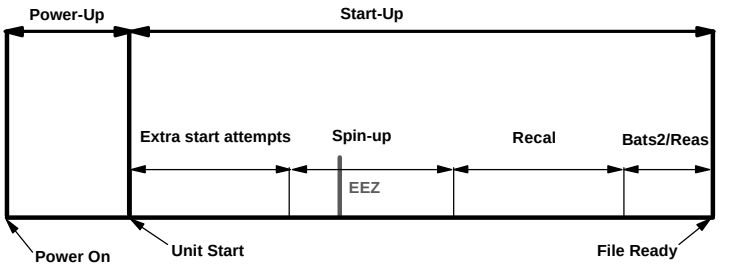
Operating/nonoperating vibration

Due to the complexity of this subject, it is recommended that customers contact their IBM representatives for further information.

Operating shock

No hard errors will occur to the drive when subjected to a 10G half sine wave shock pulse of 2 milliseconds duration.

The shock pulses are applied in each of three mutually perpendicular axes, one axis at a time.



Nonoperating shock
No hard errors will occur if the unpackaged drive is subjected to a 20 millisecond square pulse shock of 35 Gs or less to all three axes, one direction at a time.

No hard errors will occur if the unpackaged drive is subjected to a 180 inches per second velocity change square pulse shock of 50 Gs or less to all three axes, one direction at a time.

No hard errors will occur if the unpackaged drive is subjected to a 2 millisecond half sine wave shock of 140 Gs or less to all three axes, one direction at a time.

Rotational shock
The actuator will remain latched in the disk landing zone if the unpackaged drive is subjected to a 2 millisecond half sine wave shock less than 15,000 radians per second squared applied to the XY plane.

Acoustics

5.0 LwA idle.
5.5 LwA operating.

Acoustic degradation resulting from nonoperating shock
No degradation in A-weighted idle sound power will occur if the unpackaged drive is limited to a 2 ms half sine pulse shock of 70 Gs or less applied in the axial direction (z axis), or 150 Gs or less applied in the radial direction (x-y plane). The average A-weighted idle sound power will increase by 0.3 Bels if the unpackaged drive is subjected to a 2 ms half sine pulse shock of 110 Gs applied in the axial direction (z axis), or 210 Gs applied in the radial direction (x-y plane).

Electromagnetic compatibility

When installed in a suitable enclosure and exercised with a random accessing routine at maximum data rate, this drive meets the worldwide EMC requirements listed below.

- FCC Requirements: United States Federal Communications Commission (FCC) Rules and Regulations, Subpart B Digital Devices “Class A and B Limits”.
- CISPR 22 Requirements: Comite International Special des Perturbations Radio Electriques (International Special Committee on Radio Interference) “Class A and B Limits”.
- European Declaration of Conformity: This drive has been tested to comply with the European Council Directive 89/336/EEC and thereby bears the “CE” Mark of Conformity.
- Australian Declaration of Conformity: This drive has been tested to comply with AS/NZS 3548 and thereby bears the “C-Tick” Mark of Conformity.

Mechanical specifications

Physical dimensions

Weight	1.08 kg
Height	41.00 mm
Width	101.85 mm
Depth	147.00 mm

Notes:
1. *These are nominal weights and dimensions provided for reference only.*
2. *The weight tolerance is ±10%. Card interface types and disk quantity determine the weight variability.*

Clearances

A minimum of 2 mm clearance should be given to the bottom surface except for a 10 mm maximum diameter area around the bottom mounting holes.

There should be 7 mm of clearance between the IBM drives that are mounted with their top sides facing each other. Drives from other manufacturers may require additional spacing due to stray magnetic fields.

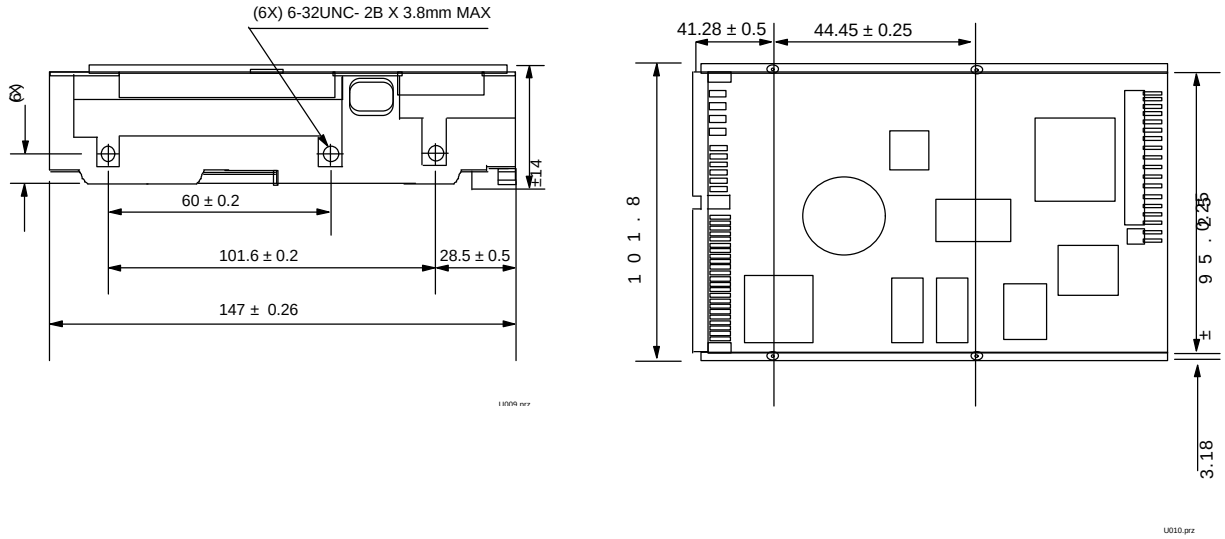
For proper cooling it is suggested that a minimum clearance of 7 mm be provided under the drive and on top of the drive.

Mounting

The drive has both side and bottom mounting holes and can be mounted with any surface facing down.

The recommended mounting screw torque is 0.8 ± 0.2 Newton-meter.

The drive side and bottom mounting hole locations and sizes are shown in the following illustrations.



Location of side and bottom mounting holes.

Note: All measurements are in millimeters. Clearance is 7 mm.

www.ibm.com/harddrive

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