

## SSD452K –

### SATA III 6Gb/s SSD

Due to Ultra-slim (fit the standard dimensions of 2.5” SATA Hard Disk Drives), huge capacity, SATA 6Gb/s speed, and low power consumption, Solid State Drive is the perfect replacement storage device for PCs, Ultrabooks, Laptops, gaming systems, and hand-held devices.



## Features

- Advanced Global Wear-Leveling and Block management for reliability
- Supports Advanced Garbage Collection
- Built-in LDPC ECC (Error Correction Code) functionality
- Supports Enhanced S.M.A.R.T. Function
- RoHS compliant
- Provides great shock resistance
- Slim, elegant, light design and aluminum case
- Non-volatile Flash Memory for outstanding data retention
- Feature a DDR3 DRAM cache
- Supports Trim and NCQ command
- Supports DEVSLP mode (optional)

## Specifications

Physical Specification			
<b>Form Factor</b>		2.5 inch	
<b>Storage Capacities</b>		128GB, 256GB, 512GB, 1TB	
<b>Dimensions</b>	<b>Length</b>	100.00 ± 0.25 mm	3.937 ± 0.01 inch
	<b>Width</b>	69.85 ± 0.25 mm	2.750 ± 0.01 inch
	<b>Height</b>	6.8 ± 0.2 mm	0.268 ± 0.008 inch
<b>Interface</b>		SATA 6 Gb/s	
<b>Input Voltage</b>		5V ± 5%	
<b>Weight (MAX)</b>		54 g	
<b>Connector</b>		SATA 22 pins connector	

Environmental Specifications	
<b>Operating Temperature</b>	Commercial (0 °C to +70 °C)
<b>Humidity</b>	5% to 95%, non-condensing
<b>Vibration</b>	5 - 800 Hz, 20 G (peak-to-peak)
<b>Shock</b>	1500 G, 0.5 ms, 3axis
<b>Warranty</b>	3 years limited

Note: Maximum transfer speed recorded

Performance								
Model P/N	ATTO		CrystalDiskMark				IOmeter	
	Max. Read (MB/s)	Max. Write (MB/s)	Sequential Read(QD32) (MB/s)	Sequential Write(QD32) (MB/s)	Random Read (4KB QD32) (MB/s)	Random Write (4KB QD32) (MB/s)	IOPS Random Read (4KB QD32)	IOPS Random Write (4KB QD32)
TS128GSSD452K	560	410	560	410	220	200	64K	75K
TS256GSSD452K	560	410	560	410	220	300	65K	75K
TS512GSSD452K	560	520	560	520	350	350	90K	85K
TS1TSSD452K	560	520	560	520	350	350	95K	85K

\* 25 °C, test on ACER X6620G, 4 GB, Windows<sup>®</sup> 7 Professional with AHCI mode, benchmark utility ATTO (version 3.0.5), unit MB/s

\*\* 25 °C, test on ACER X6620G, 4 GB, Windows<sup>®</sup> 7 Professional with AHCI mode, benchmark utility CrystalDiskMark (version 5.1.2), copied file 1000MB, unit MB/s

\*\*\* 25 °C, test on ACER X6620G, 4 GB, Windows<sup>®</sup> 7 Professional with AHCI mode, benchmark utility IOmeter2008 with 4K file size and queue depth of 32, unit IOPS

\*\*\*\* The recorded performance is obtained while the SSD is not operating as an OS disk

Power Requirements		
Input Voltage		5V ± 5% @ 25 °C
Mode P/N / Power Consumption		Typical (W)
DEVSLP		5 mW
TS128GSSD452K	Max Write*	2.8
	Max Read*	2.4
	Idle*	0.4
TS256GSSD452K	Max Write*	2.6
	Max Read*	2.4
	Idle*	0.4
TS512GSSD452K	Max Write*	2.9
	Max Read*	2.8
	Idle*	0.4
TS1TSSD452K	Max Write*	3.3
	Max Read*	3.0
	Idle*	0.5

Power on to Ready	
Power on to Ready	0.22s

Note : 1. Using Drive Master and power on to ready with proper shutdown condition

2. Enable standby immediately

Reliability			
Data Retention	1 years		
MTBF	1 million hours		
Endurance (Terabytes Written)	Capacity	*TBW	**TBW (base on JEDEC Standard)
	128 GB	220 (TB)	110 (TB)
	256 GB	440 (TB)	220 (TB)
	512 GB	880 (TB)	440 (TB)
	1 TB	1760 (TB)	880 (TB)
DWPD (Drive Writes Per Day for 3years)	1.61 DWPD		

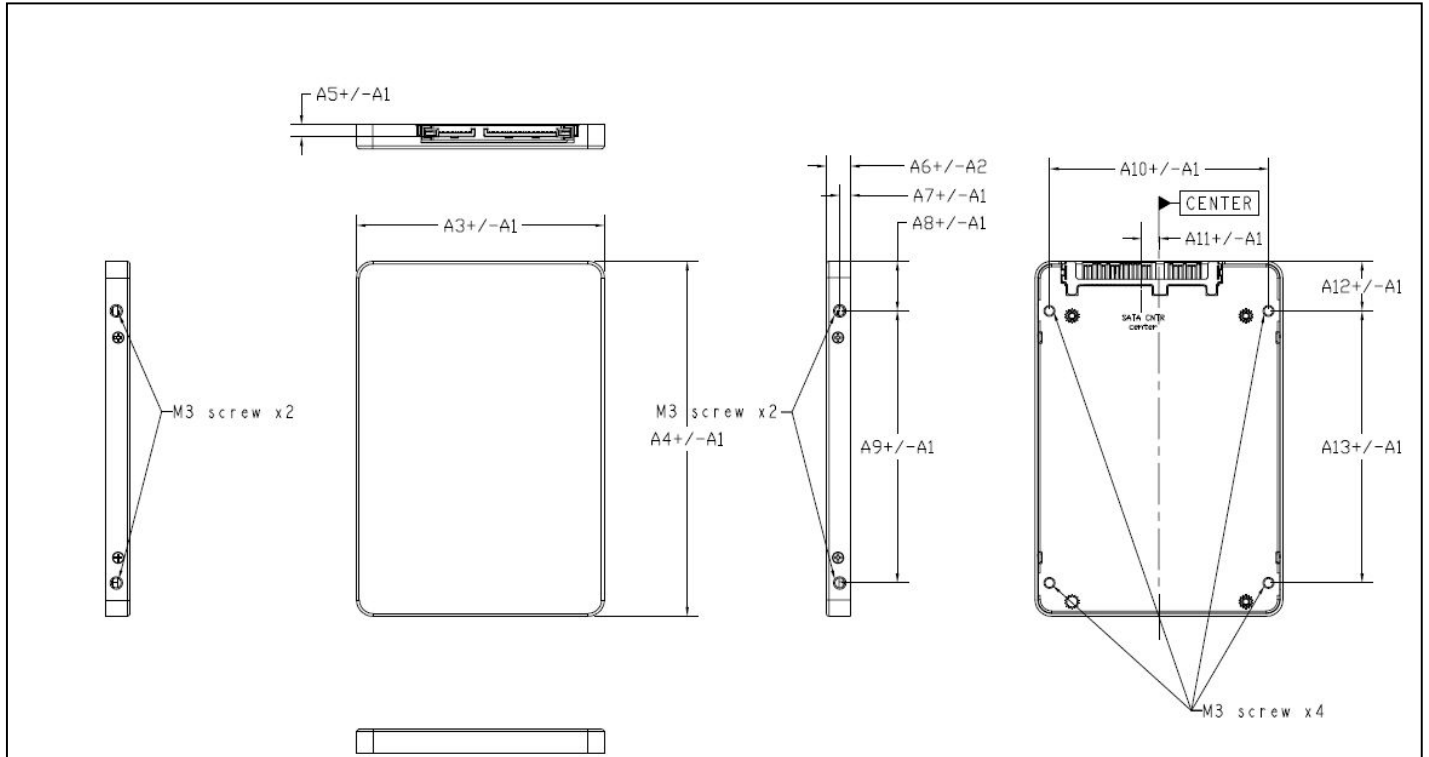
\*Tested under burn-in tool, TBW value may vary due to host environment

\*\*Tested under JESD219A endurance workloads specification

Regulations	
Compliance	CE, FCC and BSMI

## Package Dimensions

The figure below illustrates the Transcend 2.5" SATA Solid State Drive. All dimensions are in mm.



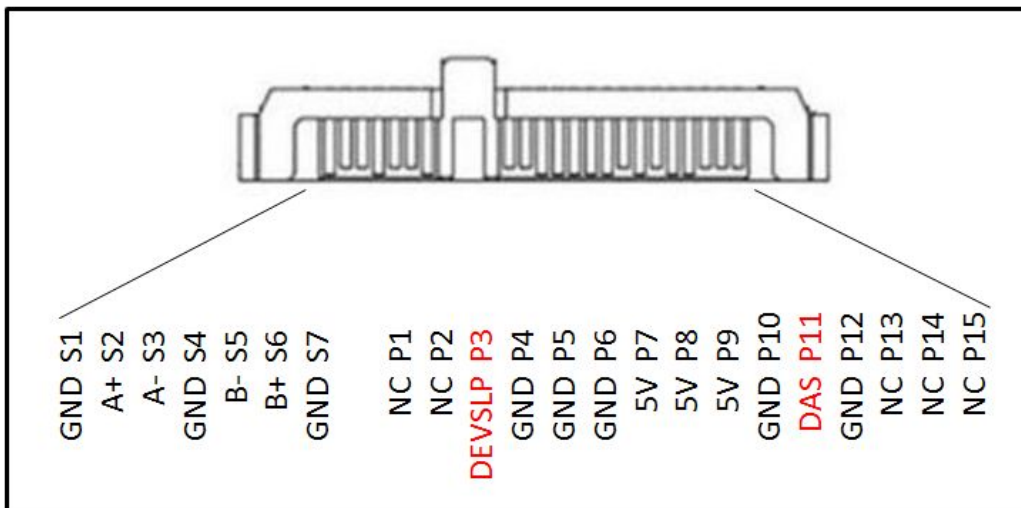
Item	Milimeter	Item	Milimeter
A1	0.25	A11	4.8
A2	0.2	A12	14.0
A3	69.85	A13	76.6
A4	100.0		
A5	3.5		
A6	6.8		
A7	3.0		
A8	14.0		
A9	76.6		
A10	61.72		

\*Note: Tighten mounting screws with no more than 2 Kgf-cm of torque.

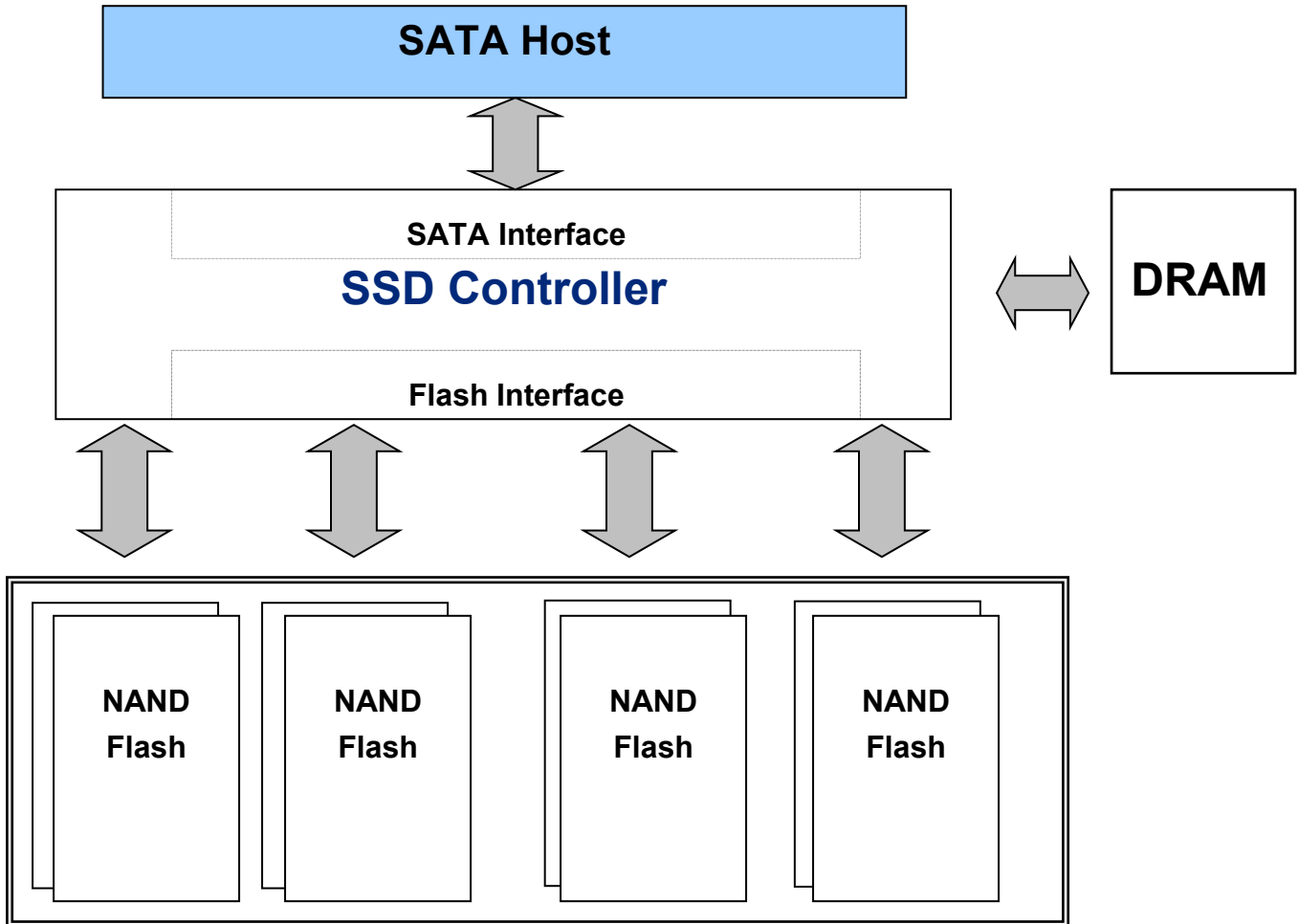
## Pin Assignments

Pin No.	Pin Name	Pin No.	Pin Name
S1	GND	S2	A+
S3	A-	S4	GND
S5	B-	S6	B+
S7	GND	P1	NC
P2	NC	P3	DEVSLP
P4	GND	P5	GND
P6	GND	P7	5V
P8	5V	P9	5V
P10	GND	P11	DAS
P12	GND	P13	NC
P14	NC	P15	NC

## Pin Layout



## Block Diagram



## Features

- **Global Wear Leveling – Advanced algorithm to enhance the Wear-Leveling Efficiency**

Global wear leveling ensures that every block has an even erase count. This helps to extend the life expectancy

- **Advanced Garbage Collection**

Transcend's SSDs have a perfect garbage collection mechanism to help improve performance. Advanced Garbage collection can efficiently improve memory management to ensure the SSD's stable performance. With Transcend advanced flash management, the drive can still keep high performance even after a long operating time.

- **LDPC ECC**

The LDPC ECC engine executes parity generation and error detection/correction features, and enhances decoding throughput and data reliability. With LDPC of correction  $1e-2$  RBER, the hard and soft decoding mechanism provides powerful error correction. Hence the controller can enhance the endurance and retention of TLC NAND and extends the SSD lifespan.

- **RAID Protection**

In case of uncorrectable errors occurring within a superblock (a pre-defined area which consist of a particular set of blocks across physical NAND units), the RAID engine recovers the uncorrectable error chunk by using a certain storage space of parity bits. Incorporated with LDPC, the RAID ensures a comprehensive level of data integrity while providing a broad range of RAID overhead protection

- **Enhanced S.M.A.R.T. function**

Transcend SSD supports S.M.A.R.T. command (Self-Monitoring, Analysis, and Reporting Technology) that allows the user to read the health information of the SSD. Transcend also define some innovated S.M.A.R.T. features which allows the user to evaluate the status of the SSD in a much more efficient way.

- **DEVSLP (optional)**

DEVSLP is a new host-controlled SATA interface power state which together enables a SATA host and device to enter an ultra-low interface power state, including the possibility of completely powering down host and device PHYs.

# ATA Command Register

This table with the following paragraphs summarizes the ATA command set.

**Command Table**

Name	Code	Subcode / Page
NOP	00h	
Data Set Management	06h	
Trim		01h
Recalibrate	1Xh	
Read Sectors	20h	
Read Sectors (w/o retry)	21h	
Read Sectors Ext	24h	
Read DMA Ext	25h	
Read Native Max Address Ext	27h	
Read Multiple Ext	29h	
Read Log Ext	2Fh	
Log Directory		00h
Extended Comprehensive SMART Error Log		03h
Device Statistics Logs		04h
<i>List of supported log pages</i>		00h
<i>General Statistics</i>		01h
<i>General Errors Statistics</i>		04h
<i>Transport Statistics</i>		06h
<b><i>SSD Statistics</i></b>		<b>07h</b>
Extended SMART Self-test Log		07h
NCQ Error Log		10h
SATA Phy Event Counters Log		11h
Identify Device Data Log		30h
<i>List of Supported Pages</i>		00h
<i>Copy of IDENTIFY DEVICE Data</i>		01h



	<i>Capacity</i>	02h
	<i>Supported Capabilities</i>	03h
	<i>Current Settings</i>	04h
	<i>ATA Strings</i>	05h
	<i>Security</i>	06h
	<i>Serial ATA</i>	08h
Write Sectors	30h	
Write Sectors Ext	34h	
Write DMA Ext	35h	
Set Max Address Ext	37h	
Write Multiple Ext	39h	
Write DMA FUA Ext	3Dh	
Write Log Ext	3Fh	
Selective Self-Test log(SMART)		09h
Host Specific(SMART)		80h~9Fh
SCT Command/Status(SCT)		E0h
SCT Data Transfer(SCT)		E1h
Read Verify Sectors	40h	
Read Verify Sectors (w/o retry)	41h	
Read Verify Sectors Ext	42h	
Write Uncorrectable Ext	45h	
Pseudo-UECC with logging		55h
Read FPDMA Queued	60h	
Write FPDMA Queued	61h	
Seek	7xh	
Execute Device Diagnostic	90h	
Initialize Drive Parameters	91h	
Download Microcode	92h	
Download with offsets and save microcode for immediate and future use.		03h
Download (without offsets) and save microcode		07h

Download with offsets and save microcode for future use / Activate downloaded microcode		0Eh/0Fh
SMART	B0h	
Read Data		D0h
Read Thresholds		D1h
Enable/Disable Attr Autosave		D2h
Exec Off-line Immediate		D4h
<i>Execute Off-Line routine</i>		00h
<i>Execute Short Self-test routine (Off-Line)</i>		01h
<i>Execute Extended Self-test routine (Off-Line)</i>		02h
<i>Abort Off-Line Self-test routine</i>		7Fh
<i>Execute Short Self-test routine (Captive)</i>		81h
<i>Execute Extended Self-test routine (Captive)</i>		82h
Read Log Sector		D5h
Write Log Sector		D6h
Enable Operations		D8h
Disable Operations		D9h
Return Status		Dah
Sanitize Device	B4h	
Sanitize Status Ext		00h
Block Erase Ext		12h
Sanitize Freeze Lock Ext		20h
Read Multiple	C4h	
Write Multiple	C5h	
Set Multiple Mode	C6h	
Read DMA	C8h	
Read DMA (w/o retry)	C9h	
Write DMA	CAh	
Write DMA (w/o retry)	CBh	
Write Multiple FUA Ext	CEh	
Standby Immediate	E0h	

Idle Immediate	E1h	
Standby	E2h	
Idle	E3h	
Read Buffer	E4h	
Check Power Mode	E5h	
Sleep	E6h	
Flush Cache	E7h	
Write Buffer	E8h	
Flush Cache Ext	EAh	
Identify Device	ECh	
Set Features	EFh	
Security Set Password	F1h	
Security Unlock	F2h	
Security Erase Prepare	F3h	
Security Erase Unit	F4h	
Security Freeze Lock	F5h	
Security Disable Password	F6h	
Read Native Max Address	F8h	
Set Max Address	F9h	
Set Max Set Password		01h
Set Max Lock		02h
Set Max Unlock		03h
Set Max Freeze Lock		04h
Set Max Set Password DMA		05h
Set Max Unlock DMA		06h

## SMART Data Structure

BYTE	F / V	Description
0-1	X	Revision code
2-361	X	Vendor specific
362	V	Off-line data collection status
363	X	Self-test execution status byte
364-365	V	Total time in seconds to complete off-line data collection activity
366	X	Vendor specific
367	F	Off-line data collection capability
368-369	F	SMART capability
370	F	Error logging capability 7-1 Reserved 0 1=Device error logging supported
371	X	Vendor specific
372	F	Short self-test routine recommended polling time (in minutes)
373	F	Extended self-test routine recommended polling time (in minutes)
374	F	Conveyance self-test routine recommended polling time (in minutes)
375-385	R	Reserved
386-395	F	Firmware Version/Date Code
396-399	F	Reserved
400-409	V	SMI2258TLC
410-510	X	Vendor specific
511	V	Data structure checksum
<p>F = content (byte) is fixed and does not change.</p> <p>V= content (byte) is variable and may change depending on the state of the device or the commands executed by the device.</p> <p>X= content (byte) is vendor specific and may be fixed or variable.</p> <p>R= content (byte) is reserved and shall be zero.</p>		

## SMART Attributes

The following table shows the vendor specific data in byte 2 to 361 of the 512-byte SMART data

Attribute ID (hex)	Raw Attribute Value							Attribute Name
	MSB						LSB	
01	MSB	00	00	00	00	00	00	Read Error Rate
05	LSB	MSB	00	00	00	00	00	Reallocated sectors count
09	LSB	-	-	MSB	00	00	00	Power-on hours
0C	LSB	-	-	MSB	00	00	00	Power Cycle Count
94	LSB	-	-	MSB	00	00	00	SLC Total Erase Count
95	LSB	-	-	MSB	00	00	00	SLC Max Erase Count
96	LSB	-	-	MSB	00	00	00	SLC Min Erase Count
97	LSB	-	-	MSB	00	00	00	SLC Average Erase Count
9F	LSB	-	-	MSB	00	00	00	DRAM one bit error count
A0	LSB	-	-	MSB	00	00	00	Uncorrectable sectors count when read/write
A1	LSB	MSB	00	00	00	00	00	Number of valid spare blocks
A3	LSB	MSB	00	00	00	00	00	Number of initial invalid blocks
A4	LSB	-	-	MSB	00	00	00	TLC Total erase count
A5	LSB	-	-	MSB	00	00	00	TLC Maximum erase count
A6	LSB	-	-	MSB	00	00	00	TLC Minimum erase count
A7	LSB	-	-	MSB	00	00	00	TLC Average erase count
A8	LSB	-	-	MSB	00	00	00	Max Erase count of spec
A9	LSB	-	-	MSB	00	00	00	Remain Life (percentage)
B1	LSB	-	-	MSB	00	00	00	Total wear level count
B5	LSB	-	-	MSB	00	00	00	Total program fail count
B6	LSB	MSB	00	00	00	00	00	Total erase fail count
C0	LSB	MSB	00	00	00	00	00	Power-off retract Count
C2	MSB	00	00	00	00	00	00	Enclosure temperature
C3	LSB	-	-	MSB	00	00	00	Hardware ECC recovered
C4	LSB	-	-	MSB	00	00	00	Reallocation event count
C7	LSB	MSB	00	00	00	00	00	Ultra DMA CRC Error Count
E8	LSB	MSB	00	00	00	00	00	Available reserved space
F1	LSB	-	-	-	-	-	MSB	Total LBA written (each write unit = 32MB)
F2	LSB	-	-	-	-	-	MSB	Total LBA read (each read unit = 32MB)
F5	LSB	-	-	-	-	-	MSB	Flash write sector count

## Ordering Information

Capacity	Model P/N
128GB	TS128GSSD452K
256GB	TS256GSSD452K
512GB	TS512GSSD452K
1TB	TS1TSSD452K

The technical information above is based on industry standard data and has been tested to be reliable. However, Transcend makes no warranty, either expressed or implied, as to its accuracy and assumes no liability in connection with the use of this product. Transcend reserves the right to make changes to the specifications at any time without prior notice.



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Revision History		
Version	Date	Modification Content
V1.0	2019/08/14	Initial Release