DATASHEET

RELEASED 5/23/17

48-Channel Analog Multiplexer, Kelvin

RHD8542

Features

- 48 Kelvin measurement channels provided by six 16-channel multiplexers
- Single power supply operation at +5V
- Radiation performance
  - Total Dose: >1 Mrad(Si), Dose rate = 50-300 rad(Si)/s
  - ELDRS Immune
  - SEL Immune: >100MeV-cm^2/mg
  - Neutron Displacement Damage: >10^{14} neutrons/cm^2
- Full military temperature range
- Low power consumption < 33.6 mW
- CMOS analog switching allows rail to rail operation and low switch impedance
- One address bus (A0-3) and three enable lines afford flexible organization
- Designed for aerospace and high reliability space applications
- Packaging – Hermetic ceramic
  - 96 leads, 1.320"Sq x 0.200"Ht quad flat pack
  - Weight - 15 grams max
- **Radiation Hardness Assurance Plan: DLA Certified to MIL-PRF-38534, Appendix G.**

General Description

The RHD8542 is a radiation hardened, single supply, 48-Channel Mul0tiplexer MCM (multi-chip module). The RHD8542 design uses specific circuit topology and layout methods to mitigate total ionization dose effects and single event latchup. These characteristics make the RHD8542 especially suited for the harsh environment encountered in Deep Space missions. It is available in a 96 lead High Temperature Co-Fired Ceramic (HTCC) Quad Flatpack (CQFP). It is guaranteed operational from -55°C to +125°C. Available screened in accordance with MIL-PRF-38534 Class K, the RHD8542 is ideal for demanding military and space applications.

Organization and Application

The RHD8542 consists of forty-eight (48) Kelvin measurement channels addressable by bus A_0~A_3 in three 16 channel blocks, each block enabled separately. Each block connects the addressed channel to two outputs, "Output" and "Current". This technique enables selecting and reading a remote resistive sensor without the MUX resistance being part of the measurement. For grounded sensors, this is done by passing current to the sensor by means of the "Current" pin and reading the resultant voltage (proportional to the sensor resistance) at the "Output" pin.

The device will not latch with SEU events to above 100 MeV-cm^2/mg. Total dose degradation is minimal to above 1 Mrad(Si). Displacement damage environments to neutron fluence equivalents in the mid 10^{14} neutrons per cm^2 range are readily tolerated. There is no sensitivity to low-dose rate (ELDRS) effects. SEU effects are application dependent.

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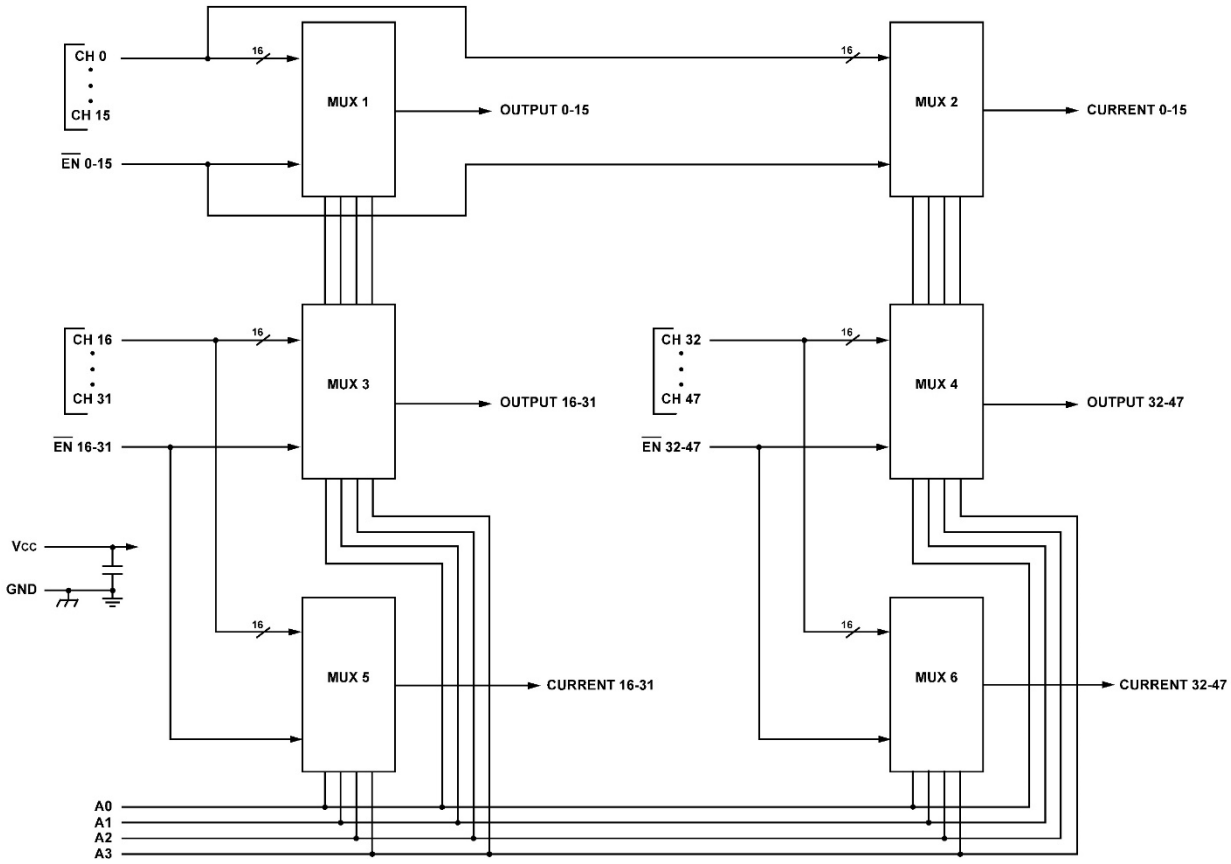

RHD8542 48−Channel Analog MUX Block Diagram

Absolute Maximum Ratings 1/

Parameter	Range	Units
Case Operating Temperature Range	-55 to +125	°C
Storage Temperature Range	-65 to +150	°C
Supply Voltage $+V_{CC}$ (Pin 44)	+7.0	V
Digital Input Overvoltage V_{EN} (Pins 5, 91, 92), V_A (Pins 1, 3, 93, 95)	< V_{CC} +0.4 > GND -0.4	V V
Analog Input Over Voltage V_{IN} (CH0-CH47)	< V_{CC} +0.4 > GND - 0.4	V
Input Current	±10	mA

Note:

1) All measurements are made with respect to ground.

Notice: Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. These are stress rating only; functional operation beyond the 'Operation Conditions' is not recommended and extended exposure beyond the 'Operation Conditions' may affect device reliability.

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Recommended Operating Conditions 1/

Symbol	Parameter	Typical	Units
$+V_{CC}$	Power Supply Voltage	+5.0	V
V_{ENL}, V_{AL}	Logic Low Level	GND to 30% V_{CC}	V
V_{ENH}, V_{AH}	Logic High Level	70% V_{CC} to V_{CC}	V

DC Electrical Performance Characteristics 1/

(Tc = -55°C to +125°C, $+V_{CC}$= +5V - Unless otherwise specified)

Parameter	Symbol	Conditions		MIN	MAX	Units
Supply Current $+V_{CC}$	$+I_{CC}$	$\overline{EN}$ = 30% V_{CC}		0	4.8	mA
	$+I_{SBY}$	$\overline{EN}$ = 70% V_{CC}		0	1.2	mA
Address Input Current A(0-3), 7/	$I_{AL}(0\text{-}3)_A$	V_A = 30% V_{CC}	+25°C	-30	30	nA
			+125°C	-300	300	nA
	$I_{AH}(0\text{-}3)_A$	V_A = 70% V_{CC}	+25°C	-30	30	nA
			+125°C	-300	300	nA
Enable Input Current $\overline{EN}$, 7/	$I_{ENL}(0\text{-}15)$ $I_{ENL}(16\text{-}31)$ $I_{ENL}(32\text{-}47)$	$V_{EN}(0\text{-}15)$ = 30% V_{CC}	+25°C	-10	10	nA
			+125°C	-100	100	nA
	$I_{ENH}(0\text{-}15)$ $I_{ENH}(16\text{-}31)$ $I_{ENH}(32\text{-}47)$	$V_{EN}(0\text{-}15)$ = 70% V_{CC}	+25°C	-10	10	nA
			+125°C	-100	100	nA
High Input Leakage Current (CH0-CH47), 7/	I_{INLK_5}	V_{IN} = +5V, V_{EN} =80% V_{CC}, Output and all unused MUX inputs under test = 0V	+25°C	-10	10	nA
			+125°C	-100	100	nA
Low Input Leakage Current (CH0-CH47), 7/	I_{INLK_0}	V_{IN} = 0V, V_{EN} =80% V_{CC}, Output and all unused MUX inputs under test = +5V	+25°C	-10	10	nA
			+125°C	-100	100	nA
Output Leakage Current V_{OUT} (pins 25, 68 & 70) CURRENTS (pins 26, 67 & 69)	I_{OUTLK}	V_{OUT} = +5V, V_{EN} = 80% V_{CC}, All inputs grounded except channel being tested. 3/, 4/	+25°C	-5	5	nA
			+125°C	-50	50	nA
Switch ON Resistance OUTPUTS (pins 25, 68 & 70) CURRENTS (pins 26, 67 & 69)	$R_{DS(ON)}$	V_{IN} = 0V, V_{EN} = 30% V_{CC}, I_{OUT} = +1mA	-55°C	-	500	Ω
		V_{IN} = +2.5V, V_{EN} = 30% V_{CC}, I_{OUT} = -0.6mA	+25°C	-	750	Ω
		V_{IN} = +5V, V_{EN} = 30% V_{CC}, I_{OUT} = -1mA 2/, 3/, 5/, 6/	+125°C	-	1000	Ω

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Notes:

1) Measure inputs sequentially. Ground all unused inputs of the device under test. V_A is the applied input voltage to the address lines A(0-3).
2) V_{IN} is the applied input voltage to the input channels (CH0-CH47).
3) V_{EN} is the applied input voltage to the enable lines $\overline{EN}$ (0-15), $\overline{EN}$ (16-31) and $\overline{EN}$ (32-47).
4) V_{OUT} is the applied input voltage to the output lines OUTPUT(0-15), OUTPUT(16-31) and OUTPUT(32-47), CURRENT(16-31) and CURRENT(32-47).
5) Negative current is the current flowing out of each of the MUX pins. Positive current is the current flowing into each MUX pin.
6) The RHD8542 cannot be operated with analog inputs below 0 volts.
7) For these signals, the leakage current is the sum of the individual leakage currents.

Switching Characteristics

(Tc = -55°C to +125°C, $+V_{CC}$ = +5V - Unless otherwise specified)

Parameter	Symbol	Conditions	TEMP	MIN	MAX	Units
Address to Output Delay	t_AHL	V_{OUT} High to Low Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	t_ALH	V_{OUT} Low to High Transition	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
Enable to Output Delay	$t_{ON}EN$	V_{EN} = 30% V_{CC} (Enabled)	-55°C	10	150	ns
			+25°C	10	150	ns
			+125°C	10	200	ns
	$t_{OFF}EN$	V_{EN} = 70% V_{CC} (Disabled)	ALL	10	200	ns

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Truth Table (CH0 – CH15)

A3	A2	A1	A0	$\overline{EN}$(0-15)	"ON" Channel 1/
X	X	X	X	H	NONE
L	L	L	L	L	CH0
L	L	L	H	L	CH1
L	L	H	L	L	CH2
L	L	H	H	L	CH3
L	H	L	L	L	CH4
L	H	L	H	L	CH5
L	H	H	L	L	CH6
L	H	H	H	L	CH7
H	L	L	L	L	CH8
H	L	L	H	L	CH9
H	L	H	L	L	CH10
H	L	H	H	L	CH11
H	H	L	L	L	CH12
H	H	L	H	L	CH13
H	H	H	L	L	CH14
H	H	H	H	L	CH15

1) Between (CH0-CH15) and OUTPUT(0-15)

Truth Table (CH16 – CH31)

A3	A2	A1	A0	$\overline{EN}$(16-31)	"ON" Channel 2/
X	X	X	X	H	NONE
L	L	L	L	L	CH16
L	L	L	H	L	CH17
L	L	H	L	L	CH18
L	L	H	H	L	CH19
L	H	L	L	L	CH20
L	H	L	H	L	CH21
L	H	H	L	L	CH22
L	H	H	H	L	CH23
H	L	L	L	L	CH24
H	L	L	H	L	CH25
H	L	H	L	L	CH26
H	L	H	H	L	CH27
H	H	L	L	L	CH28
H	H	L	H	L	CH29
H	H	H	L	L	CH30
H	H	H	H	L	CH31

2) Between (CH16-CH31) and OUTPUT2(16-31)

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Truth Table (CH32 – CH47)

A3	A2	A1	A0	$\overline{EN}$(32-47)	"ON" Channel 3/
X	X	X	X	H	NONE
L	L	L	L	L	CH32
L	L	L	H	L	CH33
L	L	H	L	L	CH34
L	L	H	H	L	CH35
L	H	L	L	L	CH36
L	H	L	H	L	CH37
L	H	H	L	L	CH38
L	H	H	H	L	CH39
H	L	L	L	L	CH40
H	L	L	H	L	CH41
H	L	H	L	L	CH42
H	L	H	H	L	CH43
H	H	L	L	L	CH44
H	H	L	H	L	CH45
H	H	H	L	L	CH46
H	H	H	H	L	CH47

3) Between (CH32-CH47) and OUTPUT(32-47)

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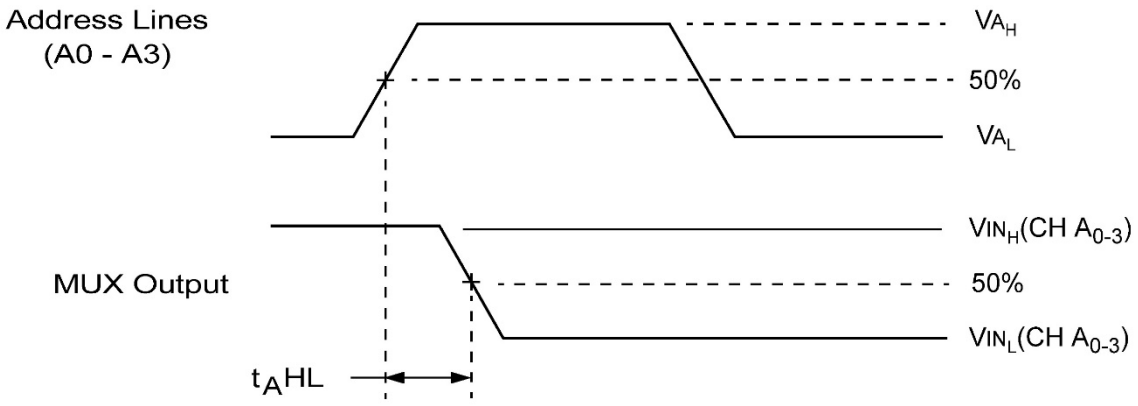
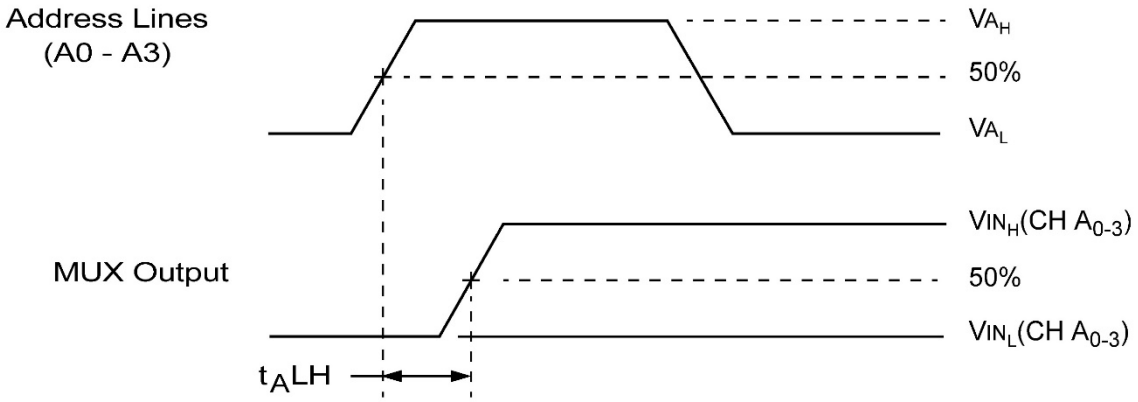
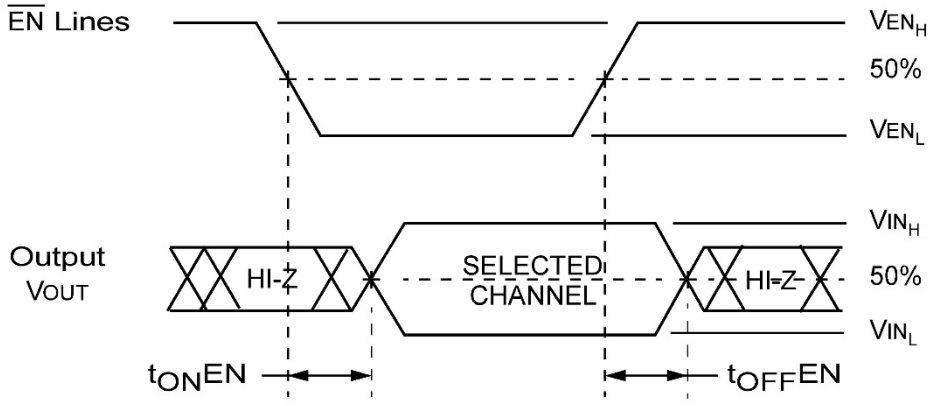


Definition of t_AHL



Definition of t_ALH



Definition of $t_{ON}EN$ and $t_{OFF}EN$
RHD8542 Switching Diagrams

Note:

1) f = 10KHz, Duty cycle = 50%.

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Pin Numbers & Functions

RHD8542 – 96 Leads Ceramic QUAD Flat Pack					
Pin #	**Function**	**Pin #**	**Function**	**Pin #**	**Function**
1	A2	33	CH11	65	CH33
2	NC	34	NC	66	CH32
3	A3	35	CH12	67	Output I(32-47)
4	NC	36	NC	68	Output V(32-47)
5	$\overline{EN}$ 0-15	37	CH13	69	Output I(16-31)
6	NC	38	NC	70	Output V(16-31)
7	CH0	39	CH14	71	GND
8	NC	40	NC	72	GND
9	CH1	41	CH15	73	CH31
10	NC	42	NC	74	CH30
11	CH2	43	NC	75	CH29
12	NC	44	$+V_{CC}$	76	CH28
13	CH3	45	NC	77	CH27
14	NC	46	NC	78	CH26
15	CH4	47	NC	79	CH25
16	NC	48	NC	80	CH24
17	CH5	49	NC	81	CH23
18	NC	50	CASE GND	82	CH22
19	CH6	51	CH47	83	CH21
20	NC	52	CH46	84	CH20
21	CH7	53	CH45	85	CH19
22	NC	54	CH44	86	CH18
23	GND	55	CH43	87	CH17
24	GND	56	CH42	88	CH16
25	Output V(0-15)	57	CH41	89	GND
26	Output I(0-15)	58	CH40	90	GND
27	CH8	59	CH39	91	$\overline{EN}$ 32-47
28	NC	60	CH38	92	$\overline{EN}$ 16-31
29	CH9	61	CH37	93	A0
30	NC	62	CH36	94	NC
31	CH10	63	CH35	95	A1
32	NC	64	CH34	96	NC

Note:

1) It is recommended that all "NC" or "no connect" pins be grounded. This eliminates or minimizes any ESD or static buildup.

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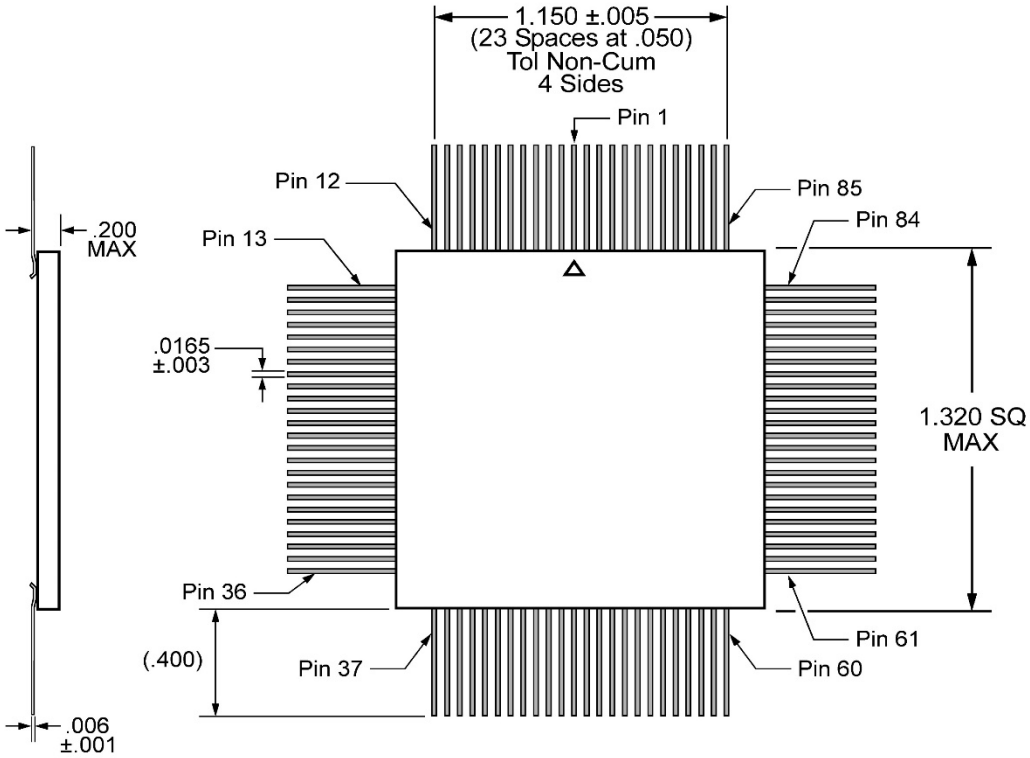

Flat Package Outline

Note:

1) Outside ceramic tie bars not shown for clarity. Contact factory for details.

Ordering Information

Model Number	DLA SMD #	Screening	Package
RHD8542-7	-	Commercial Flow, +25°C testing only	QUAD Flat Pack
RHD8542-S	-	Military Temperature, -55°C to +125°C Screened in accordance with the individual Test Methods of MIL-STD-883 for Space Applications	
RHD8542-201-1S	5962-1221001KXC	In accordance with DLA SMD	
RHD8542-901-1S	5962H1221001KXC	In accordance with DLA Certified RHA Program Plan to RHA Level "H", 1 Mrad(Si)	

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Revision History

Date	Revision	Change Description
03/30/2016	B	Import into CAES format
5/23/2017	C	Change status to Datasheet, Remove 3.3V references, Remove the resistor in the V_{CC} line, Add Max Input Current, Typical ranges in Recommended table, Change Input and Output leakage current conditions to V_{EN} = 80% V_{CC}, Add note 7/, Update switching diagram

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Datasheet Definitions

	DEFINITION
Advanced Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is still in the development stage and the datasheet **is subject to change**. Specifications can be **TBD** and the part package and pinout are **not final**.
Preliminary Datasheet	CAES reserves the right to make changes to any products and services described herein at any time without notice. The product is in the characterization stage and prototypes are available.
Datasheet	Product is in production and any changes to the product and services described herein will follow a formal customer notification process for form, fit or function changes.

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