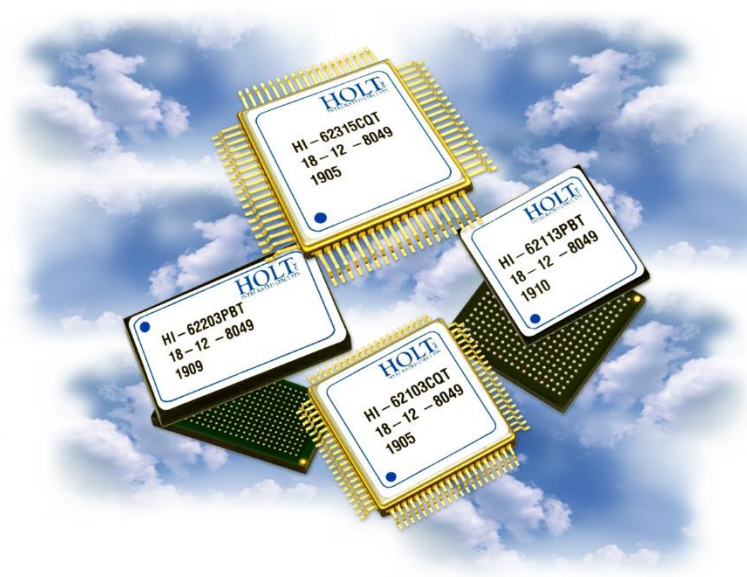


AN-577: Holt Drop-In Replacements for DDC MIL-STD-1553 Terminals



White Paper



Holt Integrated Circuits Drop-In Replacements for Data Device Corporation (DDC®)
MIL-STD-1553 Integrated Terminals:

- Total-ACE®
- Enhanced Mini-ACE®
- Micro-ACE® / Micro-ACE TE
- Mini-ACE Mark3®
- SSRT
- Mini-ACE®

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Revision Table 17

Overview

Holt Integrated Circuits has recently introduced several new families of MIL-STD-1553 terminals offering both pin and software register level compatibility with many Data Device Corporation (DDC®) MIL-STD-1553 terminals. All families provide complete form, fit, and functional replacements allowing users to drop-in to existing 1553 designs with no changes required to the existing board layout or software. This whitepaper describes the various device families and provides additional details on the package, ordering information, and cross references to DDC part numbers.

This new family of devices are fully register-level software compatible and fully pin compatible with the DDC® Mini-ACE®, Enhanced Mini-ACE®, Micro-ACE® TE, Micro-ACE, Mini-ACE® Mark3, Total-ACE®, and Simple System RT (SSRT) families of MIL-STD-1553 Terminals. The single-chip monolithic design allows Holt to offer reduced cost and lower lead times over the older traditional hybrid or multi-chip module approach. The higher maximum junction temperature of the Holt devices supports extended temperature (-55°C to +125°C) operation with no limitations on transmit duty cycle or special heat sinking required.

Table 1 - Summary of Holt Devices and equivalent DDC family.

Holt Family	DDC Family	Included Functions	Package
HI-6210xPB	Micro-ACE® TE	BC/MT/RT Protocol, SRAM, Dual Transceivers	PBGA-324
HI-6210xCQ	Mini-ACE® Mark3	BC/MT/RT Protocol, SRAM, Dual Transceivers	CQFP-80
HI-6220xPB	Total-ACE®	BC/MT/RT Protocol, SRAM, Dual Transceivers, Dual Transformers	PBGA-312
HI-6230xCQ	Enhanced Mini-ACE®	BC/MT/RT Protocol, SRAM, Dual Transceivers	CQFP-72
HI-6230xPB	Micro-ACE®	BC/MT/RT Protocol, SRAM, Dual Transceivers	PBGA-128
HI-6250xCQ	Simple System RT Enhanced Mini-ACE®	SSRT Protocol, Dual Transceivers	CQFP-72
HI-6260xCQ	Simple System RT Mark3	SSRT Protocol, Dual Transceivers	CQFP-80

Total-ACE Drop-Ins

The [HI-6220xPB](#) family is a fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface solution which includes 1553 protocol, SRAM, dual transceivers and dual isolation transformers in a single plastic BGA-312 package. The device is a direct pin compatible drop-in replacement for the DDC Total-ACE® Family of MIL-STD-1553 Terminals.

HI-6220xPBx Mechanical Differences for the PBGA-312

The DDC Total-ACE has two different package versions. The transformer coupled only version (“T8” and “U8”) and the transformer & direct coupled version (“H8” and “I8”) have different package widths of 0.6 (15.2) and 0.7 (17.8) respectively. The Holt HI-6220PBx supports both transformer & direct coupled bus connection using the smaller 0.6 (15.2) width as shown in Figure 1. The ball grid footprint is fully compatible in either case so the smaller Holt HI-6220PB package will drop-in to any Total-ACE footprint.

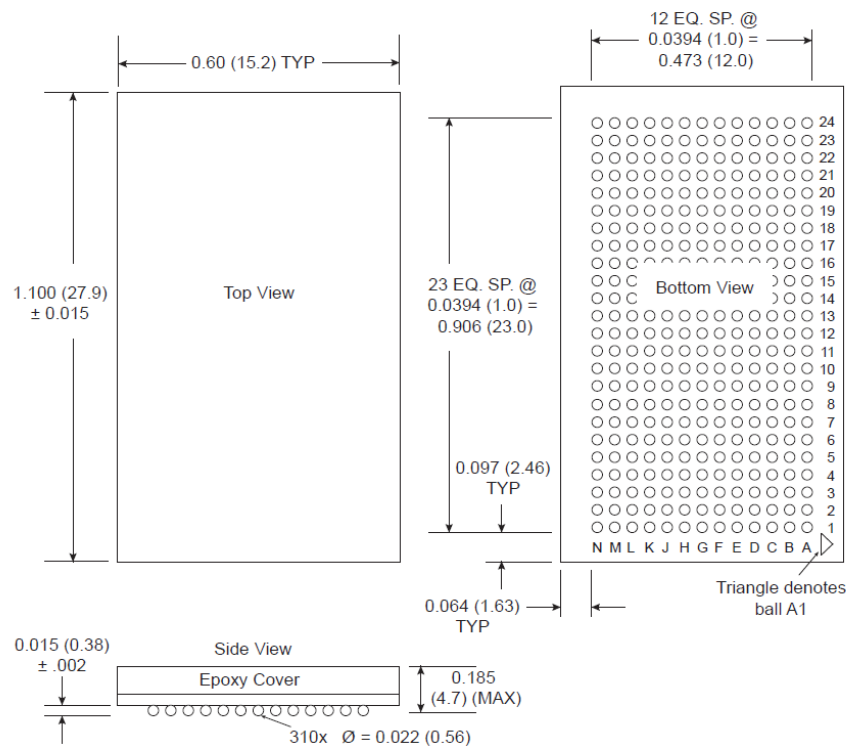


Figure 1 - HI-6220PBx Package Outline Drawing.

HI-6220xPBx Temperature Range Differences

The HI-6220PBx is available in either Industrial “I” (-40°C to +85°C) or Military “T” (-55°C to +125°C) Temperature Ranges. The DDC Total-ACE is available in Extended “-E02” (-40°C to +100°C) or Military “-102” (-55°C to +125°C). If using the -E02 version of Total-ACE, it is recommended to use the “T” grade version of the Holt HI-6220PBx to ensure full temperature requirements are met.

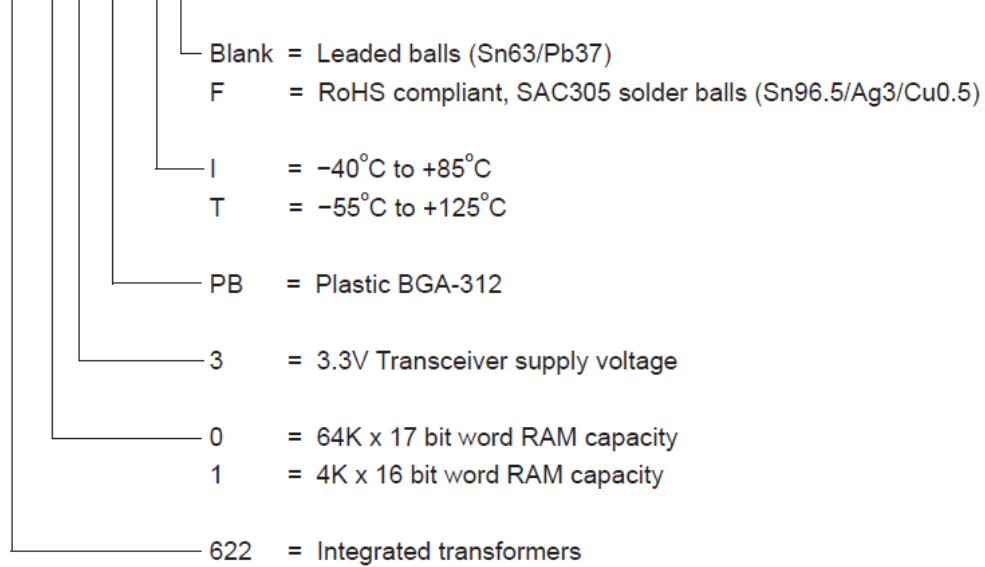
It worth noting that the Holt HI-6220xPBT and HI-6220xPBTf can operate over the full rated temperature range (-55°C to +125°C) with no limitations on transmit duty cycle or additional heat sinking due to its higher rated +175°C maximum junction temperature.

HI-6220xPBx Ordering Information and DDC Total-ACE Cross Reference List

Table 2 - Holt HI-6220PBx Cross Reference List

Holt Part Number	DDC Part Number
HI-62213PBxF	BU-64843i8-xxx
	BU-64843U8-xxx
HI-62213PBx	BU-64843T8-xxx
	BU-64843H8-xxx
HI-62203PBxF	BU-64863i8-xxx
	BU-64863U8-xxx
HI-62203PBx	BU-64863H8-xxx
	BU-64863T8-xxx

HI - 622 x 3 PB x x



Micro-ACE TE Drop-Ins

The [HI-6210xPBx](#) family is a fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface solution which includes 1553 protocol, SRAM and dual transceivers in single plastic BGA-324. The devices are direct pin compatible drop-in replacements for the DDC Micro-ACE® TE Family of MIL-STD-1553 Terminals.

HI-6210xPBx Temperature Range Differences

The HI-6210PBx is available in either Industrial “I” (-40°C to +85°C) or Military “T” (-55°C to +125°C) Temperature Ranges. The DDC Micro-ACE TE is available in Extended “-E02” (-40°C to +100°C) or Military “-102” (-55°C to +125°C). If using the -E02 version of Micro-ACE TE, it is recommended to use the “T” grade version of the Holt HI-6210PBx to ensure full temperature requirements are met.

HI-6210xPBx Ordering Information and DDC Micro-ACE TE Cross Reference List

Table 3 - Holt HI-6210PBx Cross Reference List

Holt Part Number	DDC Part Number
HI-62115PBxF	BU-64840R3-xxx
HI-62115PBx	BU-64840B3-xxx
HI-62113PBxF	BU-64843RC-xxx
HI-62113PBx	BU-64843BC-xxx
HI-62106PBx	BU-64860B4-xxx
HI-62105PBxF	BU-64860R3-xxx
HI-62105PBx	BU-64860B3-xxx
HI-62103PBxF	BU-64863RC-xxx
HI-62123PBx	BU-64743BC-xxx

HI - 621 x x PB x x

- Blank = Leaded balls (Sn63/Pb37)
- F = RoHS compliant, SAC305 solder balls (Sn96.5/Ag3/Cu0.5)
- I = -40°C to +85°C
- T = -55°C to +125°C
- PB = Plastic BGA-324
- 3 = 3.3V Transceiver supply voltage – 1553B rise/fall times
- 5 = 5.0V Transceiver supply voltage – 1553B rise/fall times
- 6 = 5.0V Transceiver supply voltage – 1553B and McAir rise/fall times
- 0 = BC/MT/RT, 64K x 17 bit word RAM capacity
- 1 = BC/MT/RT, 4K x 16 bit word RAM capacity
- 2 = RT only, 4K x 16 bit word RAM capacity

Mini-ACE Mark3 Drop-Ins

The [HI-6210CQx](#) family is a fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface solution which includes 1553 protocol, SRAM and dual transceivers in single Hermetic CQFP-80 gull wing package. The devices are direct pin compatible drop-in replacements for the DDC Micro-ACE® TE and Mini-ACE® Mark3 Families of MIL-STD-1553 Terminals.

HI-6210xCOx Process Requirements Differences

The DDC Mini-ACE Mark 3 is a traditional hybrid consisting of several internal die. DDC offers this part in a MIL-PRF-38534 compliant option. The HI-6210CQx is an integrated circuit based on a single monolithic mixed signal ASIC which includes the Protocol, SRAM, and dual transceiver. The Holt part will be offered in a MIL-PRF-38535 compliant version for customers that require a compliant part.

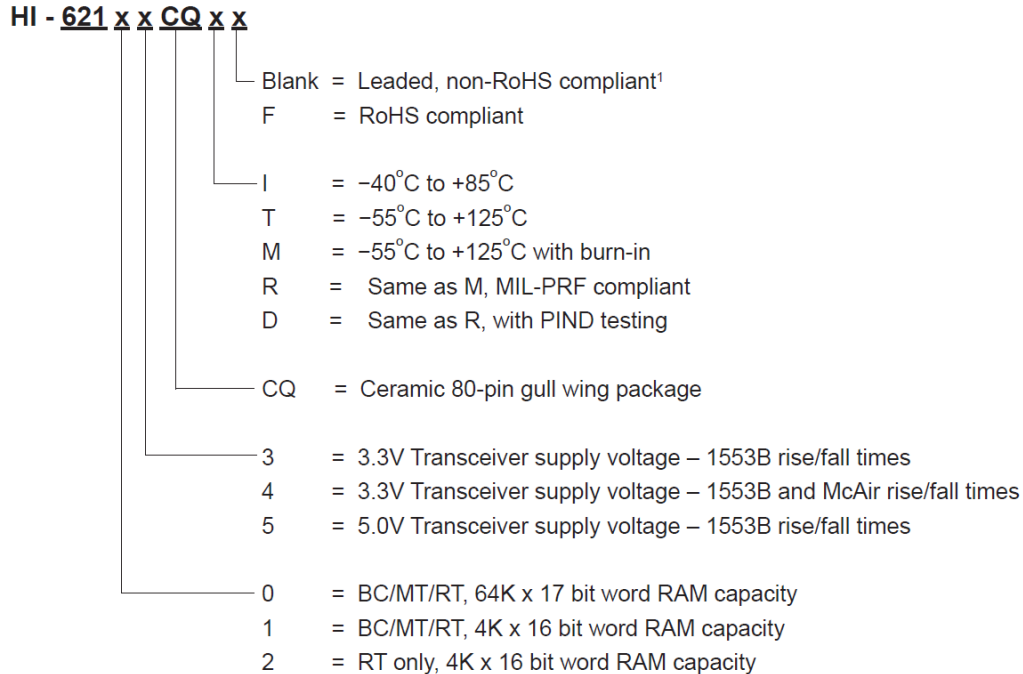
HI-6210xCOx Temperature Range Differences

The HI-6210CQx is available in either Industrial “I” (-40°C to +85°C) or Military “T” (-55°C to +125°C) Temperature Ranges. The DDC Mini-ACE Mark3 is available in a commercial “-3xx” (0°C to +70°C) temperature range. If using the -3xx version of Mini-ACE Mark3, it is recommended to use the “I” grade version of the Holt HI-6210xCOx to ensure full temperature requirements are met.

HI-6210xCOx Ordering Information and Cross Reference List

Table 4- HI-6210xCOx Cross Reference List

Holt Part Number	DDC Part Number
HI-62123CQx	BU-64743GC-xxx
HI-62124CQx	BU-64743GD-xxx
HI-62125CQx	BU-64745G3-xxx
HI-62114CQx	BU-64843GD-xxx
HI-62105CQx	BU-64863G3-xxx
HI-62104CQx	BU-64863GD-xxx
HI-62103CQx	BU-64863GC-xxx



Note 1: Solder dipped, Sn/Pb solder

Enhanced Mini-ACE Drop-Ins

The [HI-6230xCQx](#) family is a fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface solution which includes 1553 protocol, SRAM and dual transceivers in a hermetic CQFP-72 gull wing or flat pack package. The devices are direct pin compatible drop-in replacements for the DDC Enhanced Mini-ACE[®] and Micro-ACE[®] families of MIL-STD-1553 Terminals.

HI-6230xCQx Process Requirements Differences

The DDC Enhanced Mini-ACE is a traditional hybrid consisting of several internal die. DDC offers this part in a MIL-PRF-38534 compliant option. The HI-6210CQx is an integrated circuit based on a single monolithic mixed signal ASIC which includes the Protocol, SRAM, and dual transceiver. The Holt part will be offered in a MIL-PRF-38535 compliant version for customers that require a MIL-PRF compliant part.

HI-6230xCQx Temperature Range Differences

The HI-6230CQx is available in either Industrial “I” (-40°C to +85°C) or Military “T” (-55°C to +125°C) Temperature Ranges. The DDC Enhanced Mini-ACE is available in a commercial “-3xx” (0°C to +70°C) temperature range. If using the -3xx version of Mini-ACE Mark3, it is recommended to use the “I” grade version of the Holt HI-6230xCQx to ensure full temperature requirements are met.

HI-6230xCQx Logic/Ram Voltage Differences

The DDC Enhanced Mini-ACE requires that Pin 37 on certain devices are connected to +3.3V (BU-61864/61843/61743) while other devices must be connected to +5V (BU-61865/61845/61745). The Holt HI-6230xCQx has no such limitation and supports either 3.3V or 5V logic/RAM in the same device depending only on what is connected to Pin 37 (+5V / +3.3V Logic) and Pin 26 (+5V RAM).

HI-6230xCQx Ordering Information and Cross Reference List

Table 5 - HI-6230xCQx Cross Reference List

Holt Part Number	DDC Part Number
HI-62325CQxF	BU-61743G3-xxx
	BU-61745G3-xxx
HI-62325CFxF	BU-61743F3-xxx
	BU-61745F3-xxx
HI-62326CQxF	BU-61743G4-xxx
HI-62315CQxF	BU-61843G3-xxx
	BU-61845G3-xxx
HI-62315CFxF	BU-61843F3-xxx
	BU-61845F3-xxx
HI-62316CFxF	BU-61843F4-xxx
HI-62305CQxF	BU-61864G3-xxx
	BU-61865G3-xxx
HI-62305CFxF	BU-61864F3-xxx
	BU-61865F3-xxx
HI-62306CQxF	BU-61864G4-xxx
HI-62306CFxF	BU-61864F4-xxx

HI - 623 x x Cx x x

- Blank = Leaded, non-RoHS compliant¹
- F = RoHS compliant
- I = -40°C to +85°C
- T = -55°C to +125°C
- M = -55°C to +125°C with burn-in
- R = Same as M, MIL-PRF compliant
- D = Same as R, with PIND testing
- CQ = Ceramic 72-pin gull wing package
- CF = Ceramic 72-pin flat pack package
- 5 = 5.0V Transceiver supply voltage – 1553B rise/fall times
- 6 = 5.0V Transceiver supply voltage – 1553B and McAir rise/fall times
- 0 = BC/MT/RT, 64K x 17 bit word RAM capacity
- 1 = BC/MT/RT, 4K x 16 bit word RAM capacity
- 2 = RT only, 4K x 16 bit word RAM capacity

Note 1: Solder dipped Sn/Pb solder

Micro-ACE Drop-Ins

The [HI-6230xPB](#) family is a fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface solution which includes 1553 protocol, SRAM and dual transceivers in single plastic BGA-128 package. The devices are direct pin compatible drop-in replacements for the DDC Micro-ACE family of MIL-STD-1553 Terminals.

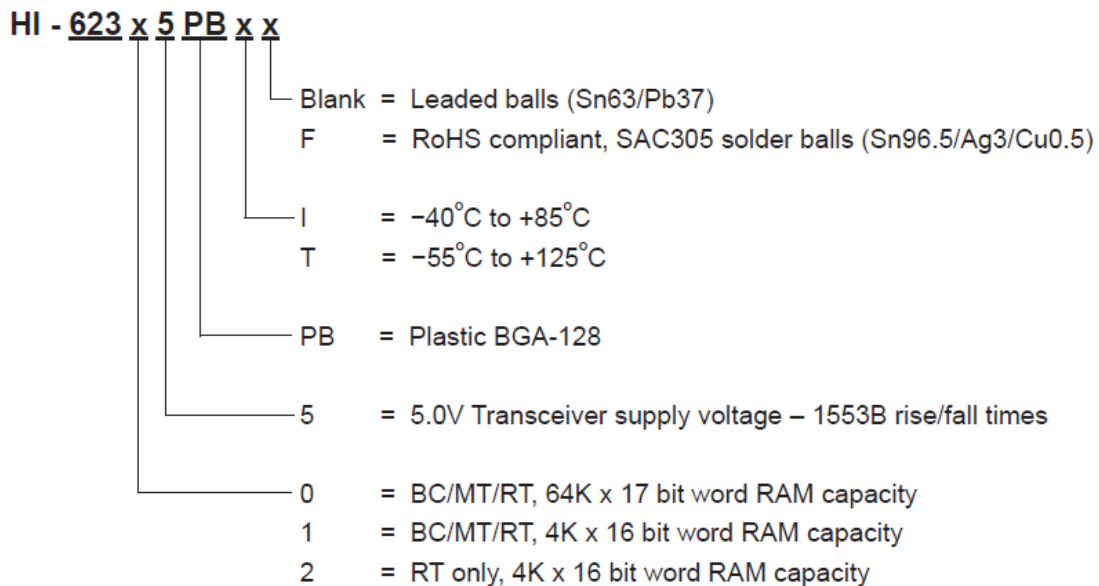
HI-6230xPB Temperature Range Differences

The DDC Micro-ACE is only available in the industrial “-202” temperature range. The Holt HI-6230xPB is available in either Industrial “I” (-40°C to +85°C) or Military “T” (-55°C to +125°C) Temperature Ranges.

HI-6230xPB Ordering Information and Cross Reference List

Table 6 - HI-6230xPB Cross Reference List

Holt Part Number	DDC Part Number
HI-62305PBIF	BU-61860R3-202
HI-62305PBI	BU-61860B3-202
HI-62315PBIF	BU-61840R3-202
HI-62315PBI	BU-61840B3-202
HI-62325PBIF	BU-61740R3-202
HI-62325PBI	BU-61740B3-202



Simple System Remote Terminal (SSRT) Drop-Ins

The [HI-6250xCQ](#) and [HI-6260xCQ](#) families are fully integrated and dual redundant MIL-STD-1553 Simple System Remote Terminal (SSRT) solutions which includes 1553 SSRT protocol and dual transceivers in a single package. The devices are direct pin compatible drop-in replacement for the DDC Enhanced Mini-ACE SSRT and SSRT Mark3 Terminals respectively.

It is worth noting that if pin compatibility is not required, then there are other options that support “SSRT Mode”. The HI-62213PBx, HI-62113PBx, and HI-62115PBx devices support SSRT Mode and will behave the same as the hardwired SSRT Devices. For more information, see Application Note AN-575 HI-62xx Family in Simple System RT Mode.

HI-6250xCQ and HI-6260xCQ Process Requirements Differences

The DDC SSRT devices are traditional hybrids consisting of several internal die. DDC offers these parts in a MIL-PRF-38534 compliant option. The Holt equivalent drop-ins are integrated circuits based on a single monolithic mixed signal ASIC which includes the SSRT Protocol and dual transceiver. The Holt parts will be optionally offered in a MIL-PRF-38535 compliant version for customers that require a MIL-PRF compliant part.

HI-6250xCQ Logic Voltage Differences

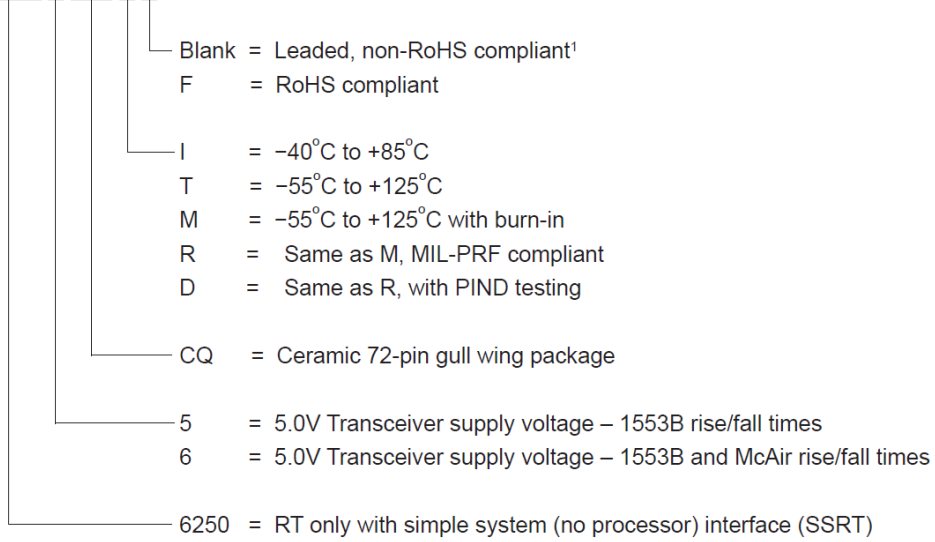
The DDC Enhanced Mini-ACE SSRT requires the user to select either a +3.3V or a +5V version of the part based on the 8th digit in the DDC Part Number. A “3” indicates +3.3V and a “5” indicates +5V. The correct Vcc voltage must be applied to pin 37 (+5V/+3.3V Logic) based on the part number. The Holt equivalent drop-in (HI-6250xCQ) can support either +5V or +3.3V on pin 37 and does not require a separate build option. For example, a single Holt Part Number BU-62505CQx can drop-in for either BU-61703G3-xxx or BU-61705G3-xxx.

HI-6250xCQ Ordering Information and Cross Referenced List

Table 7 - HI-6250xCQ and HI-6260xCQ SSRT Cross Reference Table

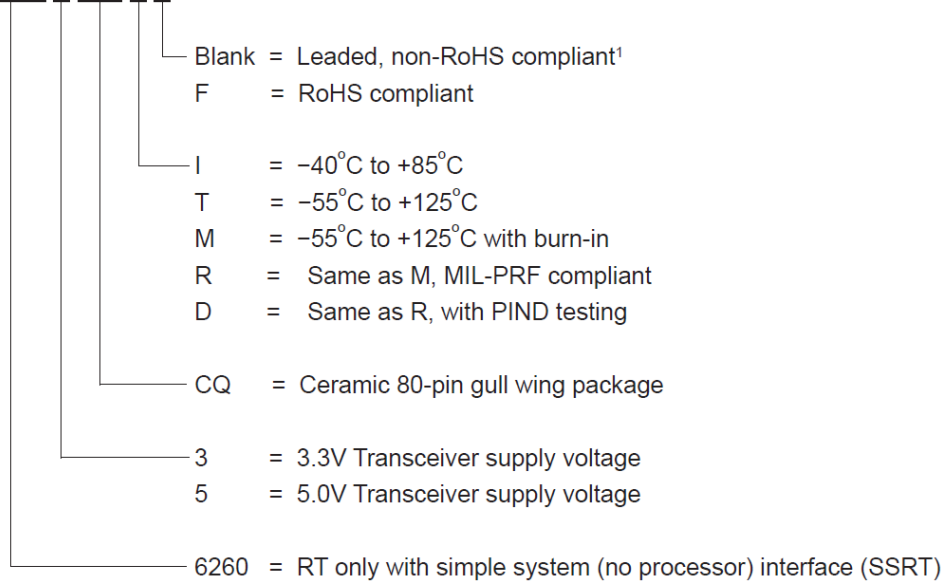
Holt Part Number	DDC Part Number
HI-62505CQx	BU-61703G3-xxx
	BU-61705G3-xxx
HI-62506CQx	BU-61703G4-xxx
	BU-61705G4-xxx
HI-62605CQx	BU-64703G3-xxx
HI-62603CQx	BU-64703GC-xxx

HI - 6250 x CQ x x



Note 1: Solder dipped Sn/Pb solder

HI - 6260 x CQ x x



Note 1: Solder dipped Sn/Pb solder

Mini-ACE and Mini-ACE Plus Drop-Ins

Holt's [HI-6230xCQx](#) family of fully integrated and dual redundant MIL-STD-1553 BC/RT/MT interface terminals include 1553 protocol, SRAM and dual transceivers in a hermetic CQFP-72 gull wing or flat pack package. The devices can be offered as a straightforward upgrade to DDC Mini-ACE and Mini-ACE Plus devices and in some cases will be pin compatible.

HI-6230xCQx Pinout Differences Compared to DDC Mini-ACE (Plus)

The HI-6230xCQx and the DDC Mini-ACE (Plus) have nearly identical pinouts with the following exceptions:

Pin	HI-6230xCQx (64K RAM)	HI-6230xCQx (4K RAM)	Mini-ACE (Plus)
25	INCMD_L/MCRESET_L (optional output)	INCMD_L/MCRESET_L (optional output)	Test Output (RX-B)
26	Vcc-RAM ¹	UPADDREN (See Below)	Test Output (RX-B*)
65	LOGIC GND ²	LOGIC GND ²	Test Output (RX-A)
67	LOGIC GND ²	LOGIC GND ²	Test Output (RX-A*)

Note 1: For 64K versions of HI-6230xCQx, it is not necessary to connect pin 26 to Vcc-RAM. This pin can be left unconnected and the device will still operate as intended.

Note 2: For both 4K and 64K versions of HI-6230xCQx, it is not necessary to connect Pins 65 and 67 to LOGIC GND. These pins can be left unconnected and the device will still operate as intended.

In addition, for versions of HI-6230xCQx with 4K of RAM, note that there are different, and potentially different pin functions on the following pins:

HI-6230xCQx with 4K of RAM		
Pin	If Pin 26 UPADDREN = Logic "1"	If Pin 26 UPADDREN = Logic "0"
8	A14	CLK_SEL_0
66	A15	CLK_SEL_1
70	A12	RT_AUTO_BOOT* - If this pin is connected to logic "0", the HI-6230xCQx will initialize in RT mode with the Busy bit set following power turn-on. If hardwired to logic "1", the HI-6230xCQx will initialize in either Idle mode (if it's an RT-only part), or in BC mode (if it's a BC/RT/MT part).
71	A13	Vcc-LOGIC

Note: For all versions of HI-6230xCQx, clock frequency selection may also be done via software.

Note: CLK_SEL1 and CLK_SEL_0 are used to designate the frequency of the CLK_IN input as follows:

CLK_SEL_1	CLK_SEL_0	Clock Frequency
0	0	10 MHz
0	1	20 MHz
1	0	12 MHz
1	1	16 MHz

We recommend you contact your Holt sales representative to discuss any concerns you have about pinout differences as there may be alternative solutions available.

HI-6230xCQx Software Differences Compared to DDC Mini-ACE (Plus)

The HI-6230xCQx is software compatible with the Mini-ACE (Plus), with the following two exceptions:

1. In the DDC BU-61588, bit 8 of the RT BIT Word Register (and in the BIT word transmitted to the BC) is CHANNEL B/A*. With the Holt HI-6230xCQx, bit 8 is BIT TEST FAIL. It will set to a value of logic "1" if there is a failure of the built-in protocol self-test.
2. With the DDC Mini-ACE (Plus), to run the protocol self-test, the host processor will write and read/verify a set of test vectors. With the HI-6230xCQx the host processor only needs to write a register bit; the self-test is then run autonomously. When the self-test is complete, an IRQ can be asserted to the host (if enabled), and the results of the self-test will be available in registers to be read. In addition, the HI-6230xCQx provides a separate self-test for the 4K or 64K internal RAM.

Self-Test Differences

The HI-62xxx family of DDC drop-in devices does have some functional differences in Self-Test capability that could affect the user. For both the Holt devices as well as the DDC Enhanced Mini-ACE equivalent devices, all the host processor needs to do is to write a register bit to initiate the built-in protocol self-test. For the DDC Enhanced Mini-ACE devices, the self-test vectors, stored in on-chip ROM, are then run autonomously. The Holt HI-62xxx devices use scan chains rather than an on chip ROM with test vectors. In both cases, when the self-test is complete, an interrupt request will be issued to the host (if enabled) and the results of the self-test will be readable via the BIT Test Status Register. If using the built-in internal self-test, then the software will operate the same with no changes required. All self-test registers are updated to match the final DDC result and the timing of the Holt self-test is limited to 32K clocks to match the DDC timing.

The main difference comes if using an external test vector file such as test.vec. Support of an external vector file is carried over from older ACE and Mini-ACE devices and was not recommended for the Enhanced Mini-ACE since the vectors are stored on chip. However, if using an external vector file, the Holt results will not match the DDC results since the functionality of many of the DDC test registers is undocumented. In fact, if using the DDC sample test.vec file, only the first 1K vectors will pass out of the 4K file. It is therefore recommended to use the built-in self-test functionality using the register bit 7 of

the Start/Reset Register to initiate the self-test since this will provide a seamless drop-in experience that will work the same with both the DDC and Holt equivalent devices.

Additional Information

To request information on Holt's ARINC 429, CAN, MIL-STD-1553 and other product lines, readers should contact Holt at (949) 859-8800, by e-mail at info@holtic.com, or visit the Holt website at www.holtic.com.

About Holt Integrated Circuits

Located in Mission Viejo, CA, Holt Integrated Circuits is a major supplier of ICs for avionics and military aircraft data bus and display applications. The company's products are specified by more than 400 manufacturers worldwide and are employed in flight control, navigation, engine management, communications, safety equipment, and in-flight entertainment systems.

Holt's range of ICs supporting the ARINC 429 standard is the widest in the industry, and its MIL-STD-1553 transceivers are recognized as the industry's smallest, having the lowest power consumption. In addition, Holt MIL-STD-1553 integrated terminals offer the most compact, cost effective solution available, integrating protocol, transceiver and transformers in a single 15x15mm package. Other data bus products include ARINC 717, CAN (ARINC 825), Ethernet, RS-485/422, discrete-to-digital and analog switches. Select products are available to DSCC SMD specifications. Holt also offers product compliant to the European Union "RoHS Directive /95/EC".

Holt Integrated Circuits is AS9100D:2016 and ISO 9001:2015 registered.

Revision Table

Revision	Date	Description of Change
AN-577, Rev. New	04-03-19	Initial Release
Rev. A	09-12-19	Correct typo in part number in Table 2 - Holt HI-6220PBx Cross Reference List Add Notes to Section "HI-6230xCQx Pinout Differences Compared to DDC Mini-ACE (Plus)" regarding Vcc-RAM and LOGIC GND connections. Added Section "Self-Test Differences".