

KUPNÍ SMLOUVA

Níže uvedeného dne, měsíce a roku smluvní strany:

Univerzita Pardubice

Právní forma: veřejná vysoká škola zřízená zákonem
 Se sídlem: Studentská 95, 532 10 Pardubice
 Zastoupená: prof. Ing. Liborem Čapkem, Ph.D., rektorem
 IČO: 00216275
 DIČ: CZ00216275
 Bankovní spojení: Komerční banka, a.s., pobočka Pardubice
 Číslo účtu: 37030561/0100
 Kontaktní osoba: [redacted]
 [redacted]

(dále jen „kupující“)

a

H TEST a.s.

Se sídlem/Místem podnikání: Na Hřebenkách 1206/25, 150 00 Praha 5
 Zapsaná: v obchodním rejstříku vedeném Městským soudem v Praze
 oddíl B, vložka 6041
 Zastoupená: [redacted] předsedou představenstva
 IČO: 25784480
 DIČ: CZ25784480
 Bankovní spojení: ČSOB a.s.
 Číslo účtu: 158009136/0300
 Kontaktní osoba: [redacted]
 [redacted]

(dále jen „prodávající“)

uzavřely dle § 2079 a násl. zákona č. 89/2012 Sb., občanský zákoník, ve znění pozdějších předpisů (dále jen „OZ“) v rámci projektu OP JAK „Rozvoj infrastrukturního zázemí na Univerzitě Pardubice (INFRA III)“, CZ.02.02.01/00/23_023/000908 tuto kupní smlouvu (dále jen „smlouva“):

I. Předmět smlouvy

1. Prodávající se zavazuje na základě své nabídky ze dne 10. 11. 2025 k veřejné zakázce s názvem „**Dodávka elektro-vybavení do laboratoří - 5. část: Vybavení pro budovy DFJP DD a DC**“ (dále jen „Veřejná zakázka“), zadávané v souladu s § 31 zákona č. 134/2016 Sb., o zadávání veřejných zakázek, ve znění pozdějších předpisů (dále jen „ZZVZ“), dodat kupujícímu v rozsahu a za podmínek stanovených touto smlouvou **elektro-vybavení** (dále jen „zboží“) dle Krycího listu nabídkové ceny, který je přílohou č. 1 této smlouvy (dále jen „příloha č. 1“), včetně příslušenství a nezbytné dokumentace a převést na kupujícího vlastnické právo k tomuto zboží. Zboží je podrobně specifikováno v příloze č. 2a této smlouvy – „Specifikace předmětu plnění pro DFJP DD“ a v příloze č. 2b této smlouvy – „Specifikace předmětu plnění pro DFJP DC“.



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2. Zboží musí být nové, nepoužité, plně funkční, nerenovované, určené pro evropský trh, kompletní a v souladu se specifikací uvedenou v příloze č. 2a a v příloze č. 2b této smlouvy tak, aby bylo možné jeho plné využití.
3. Prodávající je povinen zboží dodat do místa plnění dle čl. III. odst. 1. této smlouvy v originálních obalech výrobce zboží ve sjednaném množství, jakosti, provedení a čase.
4. Prodávající se zavazuje zajistit, aby bylo kupujícímu poskytnuto právo k užití softwaru v souladu se zákonem č. 121/2000 Sb., o právu autorském, o právech souvisejících s právem autorským a o změně některých zákonů (autorský zákon), ve znění pozdějších předpisů a nebyla užitím softwaru kupujícím dotčena práva třetích osob.
5. Prodávající je povinen při předání zboží dle čl. IV. této smlouvy předat kupujícímu prohlášení o záruce, resp. záruční list na zboží, technickou dokumentaci, uživatelské příručky a veškerou další dokumentaci potřebnou k provozování zboží v českém jazyce nebo anglickém jazyce.
6. Kupující se zavazuje zboží převzít a zaplatit prodávajícímu dohodnutou kupní cenu dle čl. II. odst. 1. této smlouvy.

II. Kupní cena

1. Smluvní strany se ve smyslu zákona č. 526/1990 Sb., o cenách, ve znění pozdějších předpisů, dohodly na této kupní ceně zboží:

Sjednaná kupní cena zboží pro DFJP DD: 495129,35 Kč bez DPH

Sjednaná kupní cena zboží pro DFJP DC: 548 748 Kč bez DPH

Celková sjednaná kupní cena zboží pro DFJP DD a DC: 1 043 877,35 Kč bez DPH

2. Sjednaná cena ve smlouvě je uvedena bez daně z přidané hodnoty a daň z přidané hodnoty bude k této ceně účtována dle daňových předpisů platných v okamžiku uskutečnění zdanitelného plnění dle zákona č. 235/2004 Sb., o dani z přidané hodnoty, ve znění pozdějších předpisů (dále jen „ZDPH“).
3. Jednotkové ceny zboží uvedené v příloze č. 1 této smlouvy jsou cenami nejvýše přípustnými a neměnnými po celou dobu účinnosti této smlouvy. Ve sjednaných cenách jsou zahrnuty veškeré náklady prodávajícího spojené s plněním povinností dle této smlouvy (např. náklady na balné, skladné, dopravu, pojištění, licence aj.). Prodávající není oprávněn účtovat žádné další částky v souvislosti s plněním dle této smlouvy.

III. Místo a doba plnění

1. Místa plnění pro dodání zboží jsou objekty kupujícího, a to Dopravní fakulta Jana Pernera, na adrese Výukové a výzkumné centrum v dopravě, 533 53 Doubravice 41, laboratoř č. 2010 (č.



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místnosti 051802010) pro zboží uvedené v příloze č. 2a, a dále objekt děkanátu DFJP na adrese Studentská 95, 532 10 Pardubice pro zboží uvedené v příloze č. 2b této smlouvy. Osobou, kterou kupující pověřil k převzetí zboží, je kontaktní osoba uvedená v úvodních ustanoveních této smlouvy (dále jen „příjemce“), popř. jiná, kupujícím pověřená, osoba.

2. Prodávající je povinen řádně dodat kupujícímu zboží do místa plnění v rozsahu dle čl. I. této smlouvy nejpozději do 30 kalendářních dnů ode dne podpisu smlouvy poslední smluvní stranou.
3. Prodávající je povinen dodat kupujícímu zboží v místě plnění v pracovních dnech od 08:00 hod. do 15:00 hod., mimo tuto dobu pouze ve výjimečných případech a po předchozí dohodě s příjemcem. Dále je povinen telefonicky vyrozumět příjemce o připravenosti dodat zboží a provést jeho zprovoznění, a to nejméně 3 pracovní dny předem.

IV. Předání a převzetí zboží

1. Povinnost prodávajícího dle čl. I. této smlouvy je považována za splněnou provedením přejímky zboží příjemcem či jeho pověřeným zástupcem a prodávajícím či jeho pověřeným zástupcem v místě a době plnění dle čl. III. této smlouvy. Kupující není povinen převzít zboží, které vykazuje jakoukoliv vadu či nedodělek.
2. Přejímkou se rozumí předání zboží včetně splnění všech podmínek stanovených v čl. I. této smlouvy prodávajícím a převzetí zboží příjemcem. Zjistí-li příjemce, že zboží trpí vadami, odmítne jeho převzetí s vytčením vad. O takovém odmítnutí sepiší smluvní strany zápis. Povinnost prodávajícího dle čl. III. odst. 2. této smlouvy tím není dotčena.
3. O provedení přejímky bude prodávajícím a příjemcem sepsán přejímací protokol s uvedením data provedení přejímky. Toto datum je dnem dodání zboží, resp. souvisejících plnění v rozsahu dle čl. I. této smlouvy a je rozhodné pro splnění povinnosti prodávajícího dle čl. III. odst. 2. této smlouvy. V přejímacím protokolu prodávající zejména uvede označení smluvních stran, označení zboží, jeho množství, čitelné jméno a podpis, příjemce uvede též své čitelné jméno a podpis.
4. Svépomocný prodej dle § 2126 a násl. OZ se nepoužije.

V. Fakturační a platební podmínky

1. Právo fakturovat vzniká prodávajícímu okamžikem přejímky zboží v rozsahu dle čl. I. této smlouvy.
2. Prodávající je povinen, po vzniku práva fakturovat, do 15 dnů vystavit a doručit kupujícímu originál daňového dokladu (dále jen „faktura“) za řádně dodané zboží za dohodnutou smluvní cenu. Faktura bude mít náležitosti řádného účetního a daňového dokladu ve smyslu příslušných právních předpisů, zejména ZDPH. Na faktuře bude uvedeno evidenční číslo této smlouvy zaznamenané v jejím názvu, číslo interní objednávky kupujícího, které kupující sdělí prodávajícímu při podpisu smlouvy, a rovněž informace, že se jedná o dodávku pro projekt „Rozvoj infrastrukturního zázemí na Univerzitě Pardubice (INFRA III)“, CZ.02.02.01/00/23_023/0009087.



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3. Prodávající vystaví celkem dvě faktury, fakturu za položky zboží pro DFJP DD uvedené v příloze č. 2a a fakturu za položky zboží pro DFJP DC uvedené v příloze č. 2b této smlouvy.
4. Společně s každou fakturou je prodávající povinen předložit též přejímací protokol potvrzený příjemcem.
5. Faktury mohou mít listinnou nebo elektronickou podobu. Splatnost faktur činí 30 dnů - v případě listinné podoby ode dne jejich prokazatelného doručení na adresu sídla kupujícího uvedenou v úvodních ustanoveních této smlouvy, v případě elektronické podoby ode dne jejich prokazatelného doručení na e-mailovou adresu: [REDACTED] Kupující tímto souhlasí s elektronickou formou fakturace ve formátu PDF a ISDOC a zavazuje se neprodleně informovat prodávajícího o jakékoliv změně e-mailové adresy pro zasílání faktur a dále se zavazuje, že zajistí řádnou funkčnost uvedené e-mailové adresy po dobu trvání této smlouvy. Jestliže bude z okolností zřejmé, že fakturu/y nelze na uvedenou e-mailovou adresu doručit, např. se zpráva vrátí jako nedoručitelná, bude neprodleně na adresu sídla kupujícího uvedenou v úvodních ustanoveních této smlouvy zaslána faktura/y v listinné podobě, přičemž však bude faktura/y splatná/é v termínu, jako by byla/y úspěšně doručena/y prostřednictvím e-mailu.
6. V případě, že faktura bude obsahovat nesprávné nebo neúplné údaje nebo k ní nebudou přiloženy požadované doklady, je kupující oprávněn vrátit ji do data její splatnosti prodávajícímu, aniž se tak dostane do prodlení se splatností. Prodávající vrácenou fakturu opraví, eventuálně vyhotoví novou, bezvadnou. V takovém případě běží kupujícímu nová doba splatnosti dle odst. 5. tohoto článku ode dne doručení opravené nebo nové faktury.
7. Kupující neposkytuje zálohové platby.
8. Platby budou probíhat výhradně v Kč formou bezhotovostního převodu na účet prodávajícího uvedený v úvodních ustanoveních této smlouvy.
9. Smluvní strany se dohodly, že nastane-li v souvislosti s prodávajícím jakákoliv skutečnost, v jejímž důsledku se může vůči kupujícímu uplatnit ručení za daň odváděnou prodávajícím ve smyslu ZDPH, je kupující oprávněn nezaplatit prodávajícímu vyúčtovanou DPH a odvést ji přímo správci daně a kupující je rovněž oprávněn odstoupit od této smlouvy.
10. Prodávající prohlašuje, že na sebe přebírá nebezpečí změny okolností podle § 1765 odst. 2 OZ, § 1765 odst. 1 a § 1766 OZ se tedy ve vztahu k prodávajícímu nepoužije.

VI. Práva a povinnosti smluvních stran, vlastnické právo a nebezpečí škody na zboží

1. Prodávající je povinen při plnění této smlouvy postupovat s odbornou péčí, dodržovat obecně závazné právní předpisy, normy a další předpisy vztahující se k předmětu smlouvy, podmínky této smlouvy a pokyny kupujícího.



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2. Kupující se zavazuje poskytnout prodávajícímu při plnění předmětu této smlouvy nezbytnou součinnost.
3. Vlastnické právo ke zboží přechází z prodávajícího na kupujícího provedením přejímky zboží dle čl. IV. této smlouvy.
4. Nebezpečí škody na zboží přechází na kupujícího ve smyslu ustanovení § 2121 odst. 1 OZ provedením přejímky zboží dle čl. IV. této smlouvy.

VII. Záruka za jakost a reklamační podmínky

1. Prodávající poskytuje kupujícímu na zboží záruku za jakost a vlastnosti zboží, jež odpovídají předmětu a účelu této smlouvy, a to v délce trvání 24 měsíců ode dne provedení přejímky zboží. Sjednaná záruční doba neplatí pro zboží, na které je výrobcem tohoto zboží stanovena záruční doba delší.
2. Kupující je povinen u prodávajícího písemně (tj. i elektronicky) uplatnit zjištěné vady zboží (dále jen „reklamáce“ resp. „oznámení o reklamaci“) bez zbytečného odkladu poté, co je zjistil. Prodávající je povinen kupujícímu doručit písemné (tj. i elektronicky) vyjádření k reklamaci ve smyslu § 2117 OZ s odkazem na § 2173 OZ v době do 5 pracovních dnů po jejím obdržení. Pokud během této doby nebude kupujícímu doručeno písemné vyjádření prodávajícího k reklamované vadě, platí, že prodávající uznává reklamaci v plném rozsahu. I reklamáce odeslaná kupujícím v poslední den záruční doby se považuje za včas uplatněnou.
3. Prodávající je povinen bezplatně odstranit reklamované vady, které uznal nebo ke kterým se nevyjádřil podle odst. 2. tohoto článku, a to v místě plnění nejpozději do 30 kalendářních dnů ode dne doručení oznámení o reklamaci, nedohodnou-li se obě smluvní strany jinak.
4. Kupující má právo uplatnit reklamaci i v případě, jedná-li se o vadu zboží, kterou musel s vynaložením obvyklé pozornosti poznat již při přejímce zboží.
5. Záruční doba se automaticky prodlužuje o počet dnů uplynulých od nahlášení vady do podpisu protokolu o odstranění vady.
6. Prodávající se v záruční době zavazuje bezplatně poskytovat informace servisním technikem prostřednictvím telefonického spojení: [REDAKCE], nebo na e-mailu [REDAKCE], a to v pracovních dnech od 8:00 hod. do 16:00 hod.
7. Prodávající se zavazuje, že si v záruční době nebude účtovat cestovní či jiné náklady.

VIII. Smluvní pokuty a úrok z prodlení

1. V případě prodlení prodávajícího s dodáním zboží (či jeho části) a/nebo se splněním povinnosti dle čl. I. této smlouvy ve sjednané době dle čl. III. odst. 2. této smlouvy, je kupující oprávněn požadovat po prodávajícím zaplacení smluvní pokuty ve výši 0,1 % ze sjednané kupní ceny bez DPH z nedodané/ých položky/ek za každý i započatý den prodlení, až do výše celkové kupní ceny nedodané/ých položky/ek bez DPH.



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2. V případě prodlení prodávajícího s odstraněním vad zboží, uplatněných v záruční době dle čl. VII. odst. 3. této smlouvy, je kupující oprávněn požadovat po prodávajícím zaplacení smluvní pokuty ve výši 0,1 % ze sjednané kupní ceny bez DPH za každý i započatý den prodlení až do podpisu protokolu o odstranění vady.
3. V případě nedodržení termínu splatnosti faktury vystavené prodávajícím, je prodávající oprávněn požadovat po kupujícím úrok z prodlení v zákonné výši z dlužné částky za každý i započatý den prodlení s úhradou faktury.
4. Právo fakturovat a vymáhat smluvní pokutu a úrok z prodlení vzniká kupujícímu prvním dnem následujícím po marném uplynutí doby určené jako čas k plnění a prodávajícímu prvním dnem následujícím po marném uplynutí doby splatnosti faktury.
5. Smluvní pokuty a úrok z prodlení jsou splatné do 30 dnů ode dne doručení písemného oznámení o jejich uplatnění.
6. Smluvní strany se dohodly, že zaplacením smluvní pokuty není dotčeno právo na náhradu vzniklé majetkové či nemajetkové újmy v plné výši, a to tedy i ve výši přesahující vyúčtovanou, resp. uhrazenou smluvní pokutu, a rovněž není dotčeno plnit řádně povinnosti vyplývající z této smlouvy.
7. Smluvní pokutu je kupující oprávněn započíst proti částce fakturované prodávajícím s tím, že kontaktní osoba kupujícího bude o případné výši smluvní pokuty informovat elektronicky kontaktní osobu prodávajícího. Proávající podpisem této smlouvy uděluje k takovému postupu souhlas.

IX. Zvláštní ujednání

1. Prodávající prohlašuje, že zboží není zatíženo právy třetích osob.
2. Prodávající potvrzuje, že se plně seznámil s rozsahem a povahou dodávky týkající se předmětu výše uvedené Veřejné zakázky, a že jsou mu známy veškeré technické, kvalitativní a jiné podmínky dodávky.
3. Prodávající se zavazuje zachovávat mlčenlivost ohledně všech skutečností, se kterými se seznámí při plnění této smlouvy. Tato povinnost zavazuje i zmocněnce, zaměstnance nebo jiné pomocníky prodávajícího, kteří se podílejí na plnění této smlouvy.
4. Práva a povinnosti vyplývající z této smlouvy ani celou tuto smlouvu nemůže žádná ze smluvních stran převést anebo postoupit na třetí osobu bez předchozího písemného souhlasu druhé smluvní strany.
5. Obě smluvní strany jsou povinny si bez zbytečného odkladu sdělit písemně veškeré skutečnosti, které se dotýkají změn některého z jejich základních identifikačních údajů nebo kontaktních údajů včetně právního nástupnictví.



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6. Smluvní strany vylučují přijetí této smlouvy s jakoukoliv odchylkou, byť by to byla odchylka, která podstatně nemění původní podmínky. Totéž platí i pro sjednávání jakýchkoliv změn této smlouvy.
7. Ustanovení této smlouvy je třeba vykládat v souladu se zadávacími podmínkami k Veřejné zakázce, zejména podmínkami stanovenými v zadávací dokumentaci Veřejné zakázky a v souladu s nabídkou prodávajícího.
8. Kupující je oprávněn, resp. stanoví-li tak právní předpis, povinen, uzavřenou smlouvu zveřejnit v souladu s právními předpisy a prodávající s tímto souhlasí.
9. Proávající se zavazuje spolupůsobit při výkonu finanční kontroly. Podle § 2 písm. e) zákona č. 320/2001 Sb., o finanční kontrole ve veřejné správě a o změně některých zákonů (zákon o finanční kontrole), ve znění pozdějších předpisů, je prodávající osobou povinnou spolupůsobit při výkonu finanční kontroly prováděné v souvislosti s úhradou zboží z veřejných výdajů nebo z veřejné finanční podpory. Proávající se zavazuje stejným způsobem zavázat i svoje poddodavatele.
10. Proávající je povinen uchovávat všechny doklady a dokumenty po dobu a způsobem stanoveným platnými právními předpisy (zákon č. 563/1991 Sb., o účetnictví, ve znění pozdějších předpisů a zákon č. 499/2004 Sb., o archivnictví a spisové službě a o změně některých zákonů, ve znění pozdějších předpisů).
11. Smluvní strany se dohodly, že všechny závazné projevy vůle je třeba činit písemnou formou v listinné podobě a prokazatelně doručit druhé smluvní straně na adresu sídla uvedenou v úvodních ustanoveních této smlouvy s výjimkou případů v této smlouvě uvedených, kdy postačuje elektronická podoba. Pokud smluvní strana, které je písemnost adresována, její přijetí odmítne nebo jiným způsobem zmaří, má se za to, že zásilka odeslaná s využitím provozovatele poštovních služeb došla třetí pracovní den po odeslání, byla-li však odeslána na adresu v jiném státu, pak patnáctý pracovní den po odeslání. Pokud je na doručení druhé smluvní straně vázán počátek běhu doby určené touto smlouvou a smluvní strana, které je písemnost adresována, její přijetí odmítne nebo jiným způsobem zmaří, počíná taková doba běžet následujícího dne po uplynutí třetího pracovního dne ode dne od uložení písemnosti na poštu. Toto však neplatí, využije-li některá ze smluvních stran pro doručení písemnosti datovou schránku ve smyslu zákona č. 300/2008 Sb., o elektronických úkonech a autorizované konverzi dokumentů, ve znění pozdějších předpisů.
12. Kupující deklaruje a prodávající bere na vědomí, že kupující není ve vztazích vyplývajících z této smlouvy podnikatelem.
13. Proávající odpovídá za újmu vzniklou kupujícímu nebo třetím osobám v souvislosti s plněním předmětu této smlouvy nebo nedodržením či porušením povinností vyplývajících z této smlouvy a zavazuje se ji kupujícímu nahradit.
14. Kupující zadal Veřejnou zakázku v souladu se zásadou environmentálně odpovědného zadávání. Proávající je povinen, po dodání zboží, na vlastní náklady zajistit odvoz a likvidaci odpadu, a to obalového materiálu dodaného zboží v souladu se zákonem č. 541/2020 Sb., o odpadech, v platném znění.



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15. Kupující zadává Veřejnou zakázku v souladu se zásadou sociálně odpovědného zadávání. Prodávající zajistí v rámci plnění této smlouvy legální zaměstnávání osob a zajistí pracovníkům podílejícím se na plnění této smlouvy férové a důstojné pracovní podmínky. Férovými a důstojnými pracovními podmínkami se rozumí takové pracovní podmínky, které splňují alespoň minimální standardy stanovené pracovněprávními a mzdovými předpisy. Kupující je oprávněn požadovat předložení dokladů, ze kterých dané povinnosti vyplývají a prodávající je povinen je bez zbytečného odkladu kupujícímu předložit. Prodávající je povinen zajistit splnění požadavků tohoto ustanovení smlouvy i u svých poddodavatelů. Nesplnění povinností prodávajícího dle tohoto ustanovení smlouvy se považuje za podstatné porušení této smlouvy.
16. Prodávající se zavazuje k řádnému a včasnému plnění finančních závazků svým poddodavatelům, kdy za řádné a včasné plnění se považuje plné uhrazení poddodavatelem vystavených faktur za plnění poskytnutá v rámci Veřejné zakázky, a to vždy do 30 kalendářních dnů od obdržení platby ze strany kupujícího za konkrétní plnění.
17. Je-li prodávajícím více dodavatelů v případě společné účasti ve Veřejné zakázce, nesou všichni tito dodavatelé společně a nerozdílně odpovědnost za plnění této smlouvy.
18. Prodávající prohlašuje, že se na něj nevztahují omezující opatření (mezinárodní sankce) přijatá Evropskou unií vůči Rusku a Bělorusku v souvislosti s ruskou agresí na území Ukrajiny. Splnění uvedeného ověřil i u svých poddodavatelů.
19. V případě, že se prodávající rozhodne během plnění předmětu této smlouvy využít poddodavatele, je prodávající povinen tuto skutečnost neprodleně oznámit kupujícímu, včetně sdělení identifikačních údajů daných poddodavatelů. Povinnost uvedená v předchozí větě platí i pro případ, kdy se prodávající rozhodne během plnění předmětu této smlouvy využít jiného poddodavatele, než uvedl v seznamu poddodavatelů předloženému kupujícímu před uzavřením této smlouvy. Kupující si vyhrazuje právo ze závažných důvodů konkrétního poddodavatele odmítnout.
20. Při výkonu administrativních činností souvisejících s plněním dle této smlouvy je prodávající povinen, je-li to objektivně možné, používat recyklované nebo recyklovatelné materiály, výrobky a obaly. Kupující upřednostňuje písemné podklady v elektronické podobě.
21. Prodávající se zavazuje, že nebude při výkonu své činnosti dle této smlouvy využívat produkty, nástroje ani komponenty společnosti DeepSeek, které jsou předmětem varování ze strany Národního úřadu pro kybernetickou a informační bezpečnost (dále jen „NÚKIB“) ze dne 10. 7. 2025. Prodávající je povinen při výkonu své činnosti dle této smlouvy zohlednit veškerá závazná i doporučená varování vydaná NUKIB a přenést závazky stanovené v tomto odstavci smlouvy i na své případné poddodavatele. Porušení tohoto ustanovení je považováno za podstatné porušení této smlouvy.

X. Zánik závazků

1. Zánik závazků z této smlouvy se řídí příslušnými ustanoveními OZ a touto smlouvou.



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2. Smluvní strany se dohodly, že podstatným porušením smlouvy ve smyslu § 2002 odst. 1 OZ se vedle případů specifikovaných v § 2002 OZ rozumí také:
 - a) prodlení prodávajícího s dodáním zboží (či jeho části) v dohodnutém termínu dle čl. III. odst. 2. této smlouvy delší než 30 kalendářních dnů;
 - b) prodlení kupujícího s uhrazením kupní ceny delší než 30 kalendářních dnů, přičemž prodávající je povinen před odstoupením od smlouvy kupujícího písemně upozornit na neplnění jeho závazků a poskytnout mu přiměřenou lhůtu k nápravě;
 - c) nedodržení sjednaného množství, jakosti nebo druhu zboží;
 - d) jestliže zboží nemá vlastnosti deklarované prodávajícím v této smlouvě či vlastnosti z této smlouvy vyplývající, příp. není v souladu se specifikací zboží;
 - e) jestliže prodávající ve své nabídce v rámci Veřejné zakázky, která předcházela uzavření této smlouvy, uvedl informace nebo doklady, které neodpovídají skutečnosti a měly nebo mohly mít vliv na výsledek výběrového řízení;
 - f) nesplnění povinnosti prodávajícího dle čl. IX. odst. 15. a/nebo 16. této smlouvy;
 - g) porušení prohlášení prodávajícího dle čl. IX. odst. 18. této smlouvy;
 - h) nesplnění či porušení povinnosti uvedené v čl. IX. odst. 21. této smlouvy.
3. Odstoupení od této smlouvy musí být písemné a nabývá účinnosti dnem doručení tohoto písemného oznámení druhé smluvní straně.
4. V případě odstoupení od této smlouvy jsou smluvní strany povinny vypořádat své vzájemné závazky a pohledávky stanovené v zákoně nebo v této smlouvě, a to do 30 dnů od právních účinků odstoupení nebo v dohodnuté lhůtě.
5. Ukončením účinnosti této smlouvy odstoupením od smlouvy nebo jiným způsobem nejsou dotčena práva na smluvní pokuty a náhradu újmy a další závazky, z jejichž povahy vyplývá, že mají trvat i po ukončení účinnosti této smlouvy.

XI. Závěrečná ujednání

1. V otázkách touto smlouvou výslovně neupravených se práva a povinnosti smluvních stran řídí příslušnými ustanoveními obecně závazných právních předpisů platných na území České republiky, zejména OZ a ostatními právními předpisy vztahujícími se k předmětu této smlouvy.
2. Veškeré spory, které se smluvním stranám nepodaří vyřešit smírnou cestou, budou řešeny věcně a místně příslušným soudem České republiky.
3. Tato smlouva bude uzavřena v elektronické nebo listinné podobě, v závislosti na možnostech a dohodě smluvních stran. V případě uzavření v listinné podobě bude vyhotovena ve čtyřech stejnopisech, z nichž každý má platnost originálu a každá smluvní strana obdrží po dvou z nich. V případě uzavření v elektronické podobě bude uzavřena připojením uznávaného elektronického podpisu na straně prodávajícího a kvalifikovaného elektronického podpisu na straně kupujícího. Toto ustanovení se použije obdobně i na případné dodatky této smlouvy.
4. Tato smlouva může být měněna či doplňována pouze písemnými, oboustranně dohodnutými, vzestupně číslovanými dodatky, které se stávají její nedílnou součástí. Za písemnou formu není pro tento účel považována výměna e-mailových či jiných elektronických zpráv. Neplatnost



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dodatků z důvodu nedodržení formy lze namítnout kdykoliv, a to i když již bylo započato s plněním. Za změnu smlouvy se nepovažuje změna identifikačních či kontaktních údajů.

5. Pokud bude z jakéhokoliv důvodu některé ustanovení této smlouvy shledáno neplatným, nečiní tato skutečnost neplatnou celou smlouvu. V takovém případě jsou smluvní strany povinny bez zbytečného odkladu neplatné ustanovení nahradit novým platným, jež bude odpovídat smyslu a účelu této smlouvy.
6. Tato smlouva nabývá platnosti dnem jejího podpisu poslední smluvní stranou a účinnosti dnem jejího uveřejnění v registru smluv podle zákona č. 340/2015 Sb., o zvláštních podmínkách účinnosti některých smluv, uveřejňování těchto smluv a o registru smluv (zákon o registru smluv), ve znění pozdějších předpisů. Pro účely uveřejnění nepovažují smluvní strany nic z obsahu této smlouvy ani z metadat k ní se vážících za vyloučené z uveřejnění. Případná plnění předmětu této smlouvy poskytnutá před účinností této smlouvy v souladu s podmínkami této smlouvy se považují za plnění poskytnutá podle této smlouvy.
7. Smluvní strany prohlašují, že si tuto smlouvu přečetly, a že byla ujednána po vzájemném projednání podle jejich svobodné vůle, určitě, vážně a srozumitelně, na důkaz čehož připojují oprávnění zástupci smluvních stran své podpisy.
8. Nedílnou součástí této smlouvy jsou následující přílohy:

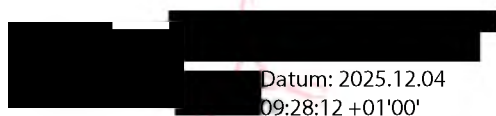
Příloha č. 1: Krycí list nabídkové ceny

Příloha č. 2a: Specifikace předmětu plnění pro DFJP DD

Příloha č. 2b: Specifikace předmětu plnění pro DFJP DC

V Pardubicích dne
za kupujícího

V Praze dne
za prodávajícího


Datum: 2025.12.04
09:28:12 +01'00'

prof. Ing. Libor Čapek, Ph.D.
rektor


Date: 2025.12.11
10:52:52 +01'00'


předseda představenstva



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Příloha č.3 Výzvy k podání nabídek

Krycí list nabídkové ceny				
Dodávka elektro-vybavení laboratoří pro budovu DFJP DC				
Číslo položky	Název položky	Počet ks	Jednotková cena v Kč	Celková cena v Kč
			bez DPH	bez DPH
1	Generátor funkčních signálů	10	8 373,00	83 730,00
2	Digitální osciloskop	10	16 991,00	169 910,00
3	Laboratorní vícekanálový zdroj	10	6 773,00	67 730,00
4	Teplotní datalogger	5	8 178,00	40 890,00
5	Stolní multimetr – digitální, stacionární	10	8 108,00	81 080,00
6	Aktivní zátěž	2	16 992,00	33 984,00
7	Proudová sonda k osciloskopu	6	11 904,00	71 424,00
	Celková nabídková cena bez DPH	53	548 748,00	

Příloha č. 3 Výzvy k podání nabídek

Krycí list nabídkové ceny				
Dodávka elektro-vybavení laboratoří pro budovu DFJP DD				
Číslo položky	Název položky	Počet ks	Jednotková cena v Kč	Celková cena v Kč
			bez DPH	bez DPH
1	Dvoukanálový generátor	5	21 198,15	105 990,75
2	LCR metr	4	22 564,10	90 256,40
3	Stolní multimetr	4	17 881,45	71 525,80
4	Osciloskop	4	8 432,00	33 728,00
5	Programovatelná elektronická zátěž	4	24 579,45	98 317,80
6	Spektrální analyzátor včetně software	2	32 036,50	64 073,00
7	Multimetr pro měření True RMS	4	7 109,40	28 437,60
8	Multimetr ruční	4	700,00	2 800,00
	Celková nabídková cena bez DPH	31	495 129,35	

Příloha č.3 Výzvy k podání nabídek

Krycí list nabídkové ceny	
Dodávka elektro-vybavení do laboratoří - 5. část: Vybavení pro budovy DFJP DD a DC pro projekt "Rozvoj infrastrukturního zázemí na Univerzitě Pardubice (INFRA III) CZ.02.02.01/00/23_023/0009087"	
Název dílčího plnění	Celková cena v Kč bez DPH
Dodávka elektro-vybavení laboratoří pro budovu DFJP DD	495 129,35
Dodávka elektro-vybavení laboratoří pro budovu DFJP DC	548 748,00
Celková nabídková cena bez DPH	1 043 877,35

Příloha č. 2b výzvy k podání nabídek

Specifikace předmětu plnění**„Dodávka elektro-vybavení laboratoří pro budovu DFJP DC “****Položka 1 – Generátor funkčních signálů – 10 ks SIGLENT SDG1022X PLUS**

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- šířka kmitočtového pásma (sinus): alespoň 25 MHz
- vzorkování minimálně 1 GSa/s, převodník 16 bit,
- dva výstupní kanály, konektory BNC,
- interface: USB, LAN, musí umožňovat připojení převodníku USB-GPIB,
- analogové a digitální modulace: AM, FM, PM, FSK, ASK, PWM,
- funkce sweep a burst,
- funkce čítače kmitočtu alespoň do 200 MHz,
- alespoň 4.3" LCD display, nebo podobný umožňující grafické zobrazení nastaveného signálu,
- stolní provedení,
- napájení ze sítě 230 V/50 Hz,
- splnění EMC normy IEC 61326-1:2021.

Položka 2 – Digitální osciloskop – 10 ks RIGOL MSO5074 + sw MSO5000-BND

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- šířka kmitočtového pásma 70 MHz a více,
- vzorkování minimálně 8 GSa/s (1 kanál),
- počet kanálů - 4 (konektory BNC),
- citlivost 1 mV až 10 V/dílek,
- časová základna 5 ns/dílek až 1 ks/dílek,
- dekódování sběrnic RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, MIL-STD-1553,
- vestavěná funkce spektrálního analyzátoru,
- vestavěné webové rozhraní pro vzdálený přístup,
- rychlé zaznamenávání průběhů: alespoň 500 000 wfms/s
- ovládání přes PC software,
- rozhraní USB host, USB device, LAN, HDMI, musí umožňovat připojení USB-GPIB převodníku,
- kapacitní dotykový LCD display s úhlopříčkou alespoň 9",
- v základním vybavení: minimálně 4 ks pasivních sond, USB kabel, napájecí kabel, návod k použití.



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Příloha č. 2b výzvy k podání nabídek

Položka 3 – Laboratorní vícekanálový zdroj – 10 ks UNI-T UDP3305S-E

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- počet kanálů – 3,
- lineární koncepce,
- dva regulovatelné kanály umožňující plynulé nastavení napětí 0-30 V DC a proudu 0-5 A,
- jeden kanál fixní: 5 V DC, 3 A,
- musí umožňovat zapojení regulovatelných kanálů: nezávisle, paralelně, sériově,
- musí umožňovat současné měření napětí a proudu pro oba regulovatelné kanály (alespoň 3 místný zobrazovač),
- zvlnění výstupního napětí maximálně 2mVrms (pro regulovaný výstup),
- indikační led pro režim konstantního napětí (CV) a konstantního proudu (CC).

Položka 4 – Teplotní datalogger – 5 ks MCR-4TC

Celé zařízení musí splňovat následující minimální technické požadavky a parametry:

- počet kanálů – 4,
- musí umožňovat připojení termočlánků: K, J, T, S, R,
- kompenzace studeného bodu,
- šumový filtr,
- zobrazení údajů na displeji,
- volba intervalu záznamu v hodnotách alespoň 100 ms, 200 ms, 500 ms, 1 s, 10 s, 30 s, 1 min, 10 min, 60 min,
- bateriové napájení,
- musí umožňovat logování na SD kartu.

Položka 5 – Stolní multimetr – digitální, stacionární – 10 ks RIGOL DM3058E

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- rozsah měření napětí DC 0 - 1000 V,
- rozsah měření napětí AC 0 - 750 V,
- šířka pásma pro měření napětí AC - 100 kHz,
- rozsah měření proudu DC - 10 A,
- rozsah měření proudu AC - 10 A,
- šířka pásma pro měření proudu 5 kHz,
- rozsah měření odporu - 100 MOhm,
- musí umožňovat dvoudrátového a čtyřdrátového měření odporu,
- rozsah měření kapacity - 10 mF,
- rozsah měření kmitočtu - 1 MHz (pro proud 10 kHz),



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Příloha č. 2b výzvy k podání nabídek

- musí umožňovat připojení teplotních snímačů (termočlánků, Pt 100),
- musí umožňovat paměti nastavení snímačů,
- musí umožňovat matematických funkcí – dB, dBm, min, max, avg,
- test diody,
- test průchodnosti – obvodu – akustický signál,
- TRUE RMS,
- USB device, USB host,
- LCD display,
- stolní provedení,
- splnění bezpečnostních požadavků dle IEC (či EN) 61010 – kategorie alespoň CAT I 1000 V a CAT II 600 V ^{1*)}
- napájení ze sítě.

Položka 6 - Aktivní zátěž – 2 ks RIGOL DL3031

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- napěťový rozsah 0-150 V,
- proudový rozsah 0-60 A,
- ztrátový výkon 350 W,
- režim konstantního proudu, napětí, výkonu, odporu,
- definování konce vybíjení, terminály pro externí monitoring napětí a proudu,
- úhlopříčka displeje alespoň 4,3“,
- konektivita RS232/USB/LAN,
- musí umožňovat konfigurace testu baterií,
- čtyřvodičové připojení (připojení silové a měřicí).

Položka 7 - Proudová sonda k osciloskopu – 6 ks FLUKE i310S

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- proudová klešťová sonda,
- rozsah měření proudu DC – 45 A/450 A,
- rozsah měření proudu AC – 30 A/300 A,
- přesnost měření proudu DC $\pm 1 \%$,
- přesnost měření proudu AC $\pm 1 \%$,
- frekvenční rozsah alespoň 20 kHz,
- BNC konektor,
- splnění bezpečnostních požadavků dle IEC (či EN) 61010 – kategorie alespoň CAT III 300 V. ^{1*)}

Dodávka přístrojů musí obsahovat dopravu do místa plnění a dále uživatelské příručky, návody a veškerou další dokumentaci potřebnou k provozování zařízení, a to v českém nebo anglickém jazyce.



**Spolufinancováno
Evropskou unií**



MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY

Příloha č. 2b výzvy k podání nabídek

1*) Pokud se v zadávacích podmínkách vyskytnou technické podmínky (normy), je účastník oprávněn navrhnout jiné řešení splňující rovnocenným způsobem požadavky vymezené takovými technickými podmínkami. Tuto skutečnost dodavatel prokáže ve své nabídce, a to zejména technickou dokumentací výrobce nebo zkušebním protokolem vydaným uznaným orgánem. Uzanými orgány se rozumí zkušební a kalibrační laboratoře nebo certifikační a inspekční orgány splňující platné evropské normy.



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SDG1000X Plus Series Function/Arbitrary Waveform Generator

Data Sheet

EN01A

SDG1062X Plus SDG1032X Plus SDG1022X Plus

Product Overview

SIGLENT's SDG1000X Plus series dual-channel function/arbitrary waveform generator, with a maximum bandwidth of 60MHz, has excellent sampling system indicators of 1GSa/s sampling rate and 16-bit vertical resolution. Based on the traditional DDS technology, the innovative TrueArb and EasyPulse technologies are used to overcome the inherent defects of DDS technology in outputting arbitrary waves and square waves/pulses. It can provide users with high-fidelity, low-jitter signals. In addition, SDG1000X Plus also provides PRBS pattern generation, sequence wave output, and dual pulse output functions to meet a wider range of application needs.

Key Features

- Dual channel, maximum output frequency 60 MHz, maximum output amplitude 20 Vpp
- 1 GSa/s digital-to-analog converter sampling rate, 16-bit vertical resolution
- Innovative TrueArb technology, based on a point-by-point architecture, supports any 24pts ~ 8Mpts Arb waveform with a sampling rate in range of 1 μ Sa/s ~ 250 MSa/s
- Supports sequence wave playback function, maximum storage depth per channel 8 Mpts
- Innovative EasyPulse technology, capable of generating lower jitter Square or Pulse waveforms, brings a wide range and extremely high precision in pulse width and rise/fall times adjustment
- Multi-pulse output function can be used to measure the switching parameters of power equipment and evaluate its dynamic characteristics
- Supports PRBS up to 40 Mbps
- Plenty of analog and digital modulation types: AM, DSB-AM, FM, PM, FSK, ASK, PSK and PWM
- Sweep and Burst function
- Harmonic function
- Waveform Combining function
- High precision Frequency Counter
- 196 built-in arbitrary waveforms
- Built-in WebServer supports instrument control via web browser
- Standard interfaces: USB Host, USB Device (USBTMC), LAN (VXI-11)
- 4.3" LCD display

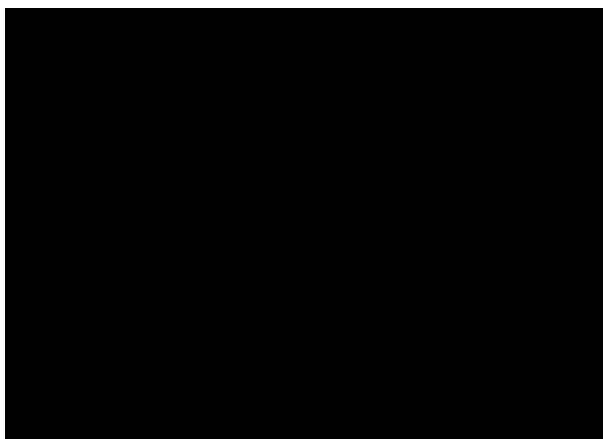


Models and Key Specifications

Model	SDG1062X Plus	SDG1032X Plus	SDG1022X Plus
Max output frequency	60 MHz	30 MHz	25 MHz
Number of channels	2		
Sampling rate	1 GSa/s (4X Interpolation)		
Vertical resolution	16 bits		
Arbitrary waveform length	8 Mpts/CH		
Max. amplitude	± 10 V		
Display	4.3" display, 480 x 272 x RGB		
Interface	Standard: USB Host, USB Device, LAN Optional: GPIB (USB-GPIB adaptor)		

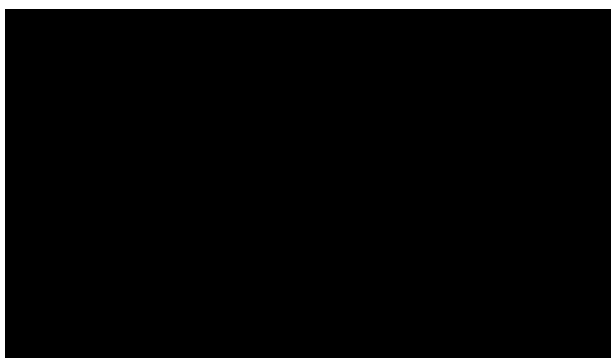
Characteristics

High-performance Sampling System

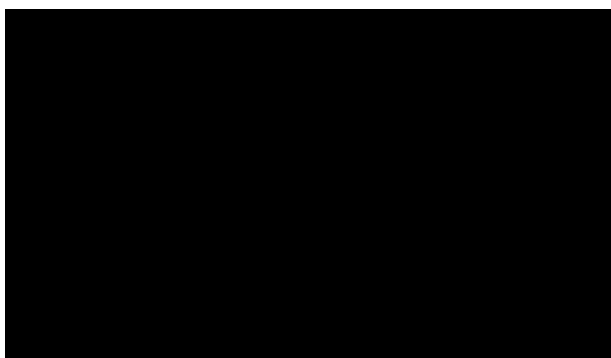


Benefiting from a 1GSa/s and 16-bit sampling system, SDG1000X Plus achieves extremely high accuracy performance in both time domain and amplitude, which results in more accurately reconstructed waveforms and lower distortion

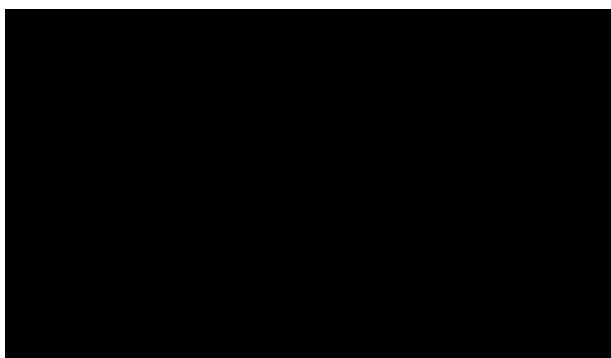
Innovative EasyPulse Technology



When a Square/Pulse waveform is generated by DDS, there will be a one-clock-jitter if the sampling rate is not an integer-related multiple of the output frequency. SDG1000X Plus EasyPulse technology successfully overcomes this weakness in DDS designs and helps to produce low jitter Square/Pulse waveforms



The rise/fall times can be set independently to the minimum of 10ns at any frequency and to the maximum of 22.4s. The adjustment step is as small as 100 ps.



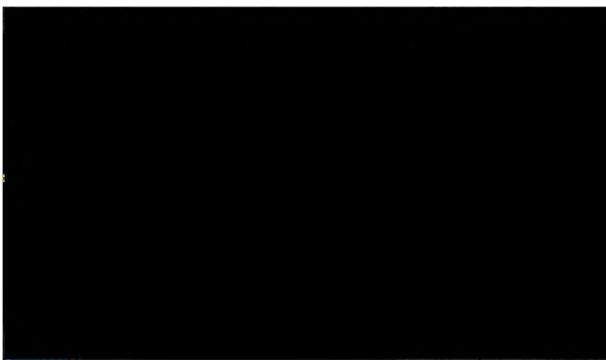
The Pulse width can be fine-tuned to the minimum of 19.4ns with the adjustment step as small as 100ps

Innovative TrueArb Technology

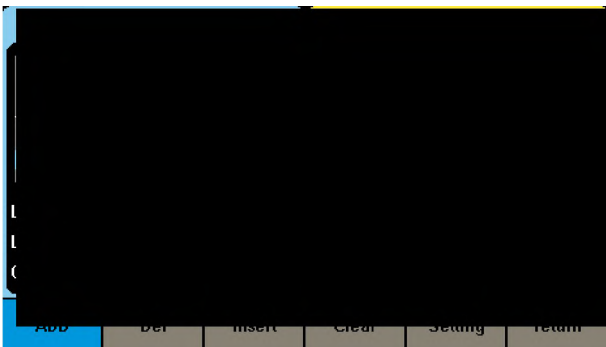


For arbitrary waveforms, TrueArb not only has all the advantages of traditional DDS, but also eliminates the probability that DDS may cause serious jitter and distortion. TrueArb generates arbitrary waveforms point by point, never skips any point so that it can reconstruct all the details of the waveform as defined.

Powerful arbitrary wave generation capability and sequence playback function



Provides sequence playback function to easily meet various testing needs. Maximum waveform storage depth reaches 8 Mpts/ch.



Easily set the number of cycle times for each waveform and the order of waveform playback.

Three operating modes: continuous, burst and single.

Three trigger sources are available: "internal", "external" and "manual".

Built-in multi-pulse output function



Built-in dual pulse output function, combined with siglent's oscilloscope, can quickly measure the switching parameters and dynamic characteristics of power devices without the need for host computer software.

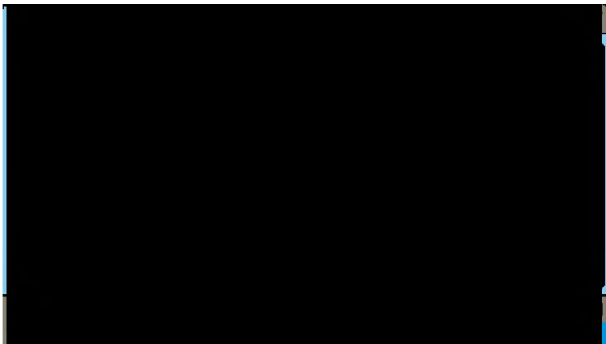


Supports up to 30 pulses, each pulse can be independently set with pulse edge and positive and negative pulse width.

PRBS pattern output

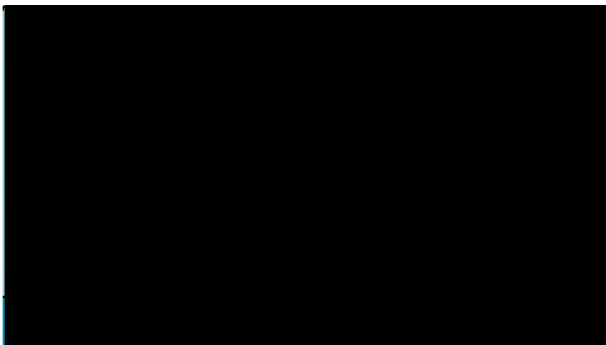


Provides PRBS3 ~ PRBS32 multiple pattern outputs, the rate is arbitrarily adjustable between 10^{-6} bps ~ 40 Mbps, and the edge is arbitrarily adjustable between 10 ns ~ 1us.



Quickly select preset level logic such as TTL, LVCMOS, LVPECL and LVDS. Differential mode allows you to easily set up two channels as a differential pair output.

Modulation



Rich modulation functions, supporting commonly used AM/DSB-AM/ FM/ PM/ ASK/ FSK/ PSK/ PWM modulation methods.

Optional internal and external modulation sources.

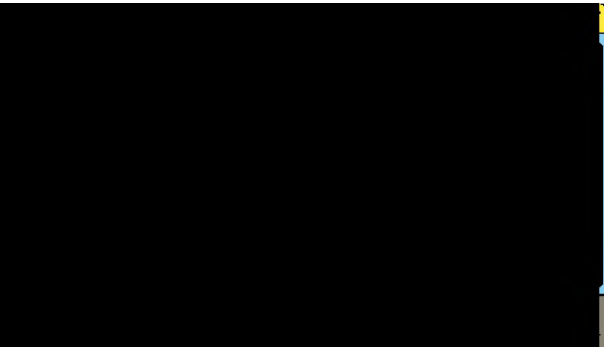
Burst



Supports two Burst modes: N cycle and Gating

Three trigger sources are available: internal, external and manual.

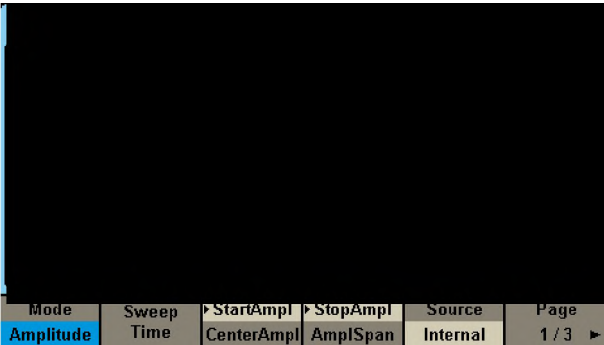
Sweep



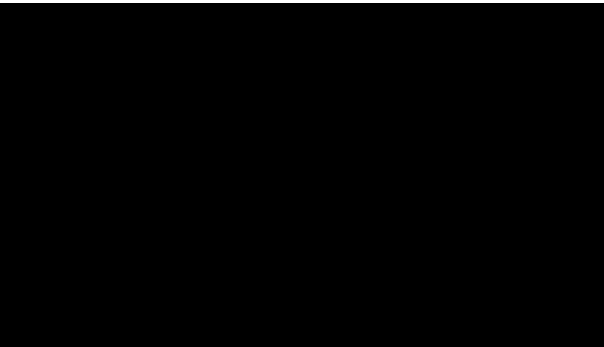
Supports two sweep modes, frequency and amplitude, to easily implement frequency sweep and amplitude sweep tests.

Supports two sweep type: linear and log, and three sweep directions of up, down and up_down.

Three trigger sources are available: internal, external and manual.

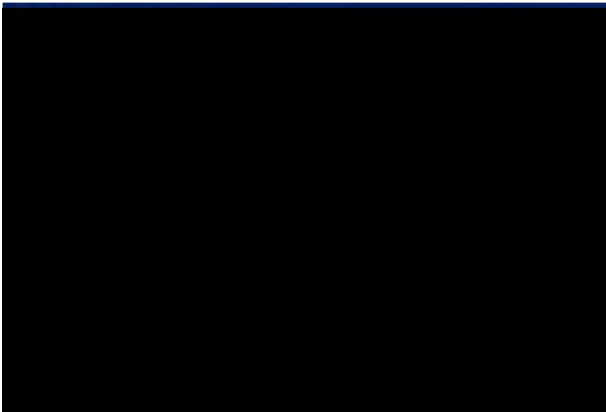


Frequency Counter



High-precision frequency counter, capable of testing the frequency range of 0.1Hz~200MHz.

Built-in WebServer



Supports instrument control through a web browser, allowing testing tasks to be completed remotely.

Specifications

Unless otherwise specified, all specifications can be guaranteed to meet the following conditions:

- Within the validity period of product calibration.
- Within the ambient temperature range of 18 °C ~ 28 °C.
- The instrument is powered on and operating for more than 30 minutes.

Frequency Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Resolution			1 μ	Hz	
Initial accuracy	-1		+1	ppm	25 °C
	-2		+2		0~40 °C
1st-year aging	-1		+1	ppm	25 °C
10-year aging	-3.5		+3.5	ppm	25 °C

Sine Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		60 M	Hz	SDG1062X Plus
	1 μ		30 M		SDG1032X Plus
	1 μ		25 M		SDG1022X Plus
Harmonic distortion (0 dBm, 50 Ω Load)			-65	dBc	$\leq$ 10 MHz
			-60		10 MHz~20 MHz (include)
			-55		20 MHz~40 MHz (include)
			-50		40 MHz~60 MHz (include)
Total Harmonic Distortion			0.075	%	0 dBm, 10 Hz~20 kHz
Non-harmonic spurious (0 dBm, 50 Ω Load)			-70	dBc	$\leq$ 50 MHz
			-65		>50 MHz

Square Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		20 M	Hz	
Rise/fall times		10		ns	10%~90%, 1Vpp, 50 Ω Load
Overshoot			3	%	100 kHz, 1Vpp, 50 Ω Load
Duty cycle	0.001		99.999	%	Limited by frequency setting
Jitter (rms), Cycle to cycle			200	ps	1Vpp, 50 Ω Load

Pulse Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition

Frequency	1 μ		20 M	Hz	
Pulse width	19.4			ns	
Pulse width accuracy			$\pm (0.01\%+0.5\text{ns})$		
Rise/fall times	10 n		22.4	s	10%~90%, 1Vpp, 50 Ω Load
Overshoot			3	%	100 kHz, 1Vpp, 50 Ω Load
Duty cycle	0.001		99.999	%	Limited by frequency setting
Jitter (rms), Cycle to cycle			200	ps	1Vpp, 10ns edge, 50 Ω Load

Noise Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
-3dB bandwidth		60		MHz	
Adjustable bandwidth range	20		60	MHz	

Ramp Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	1 μ		2 M	Hz	
Symmetry	0		100	%	
Linearity			1	%	Percentage of peak-peak output, 1kHz, 1Vpp, 100% symmetry

Arbitrary Wave characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
DDS Mode					
Frequency	1 μ		20M	Hz	Sampling rate 250 M Sa/s
Waveform length	16 k			pts	
Rise/fall times		6		ns	10% ~ 90%, 1Vpp step, 50 Ω Load
True Arb Mode					
Sampling rate	1 μ		250 M	Sa/s	
Waveform length	24		8 M	pts	
jitter (rms)			200	ps	Cycle to cycle, "010101" pattern, 1Vpp, 50 Ω Load, 250 MSa/s
Interpolation mode	0-order hold, linear				
Sequence	Run mode: Continuous, Step, Burst				

PRBS characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Bit rate	1 μ		40 M	bps	

Pattern length	2m-1, m = 3,4,...,32				
Rise/fall time	10n		1μ	s	10% ~ 90%, 1 Vpp, 50Ω Load

DC characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Output Range	-10		+10	V	HiZ Load
Accuracy	±(1%+2mV)				HiZ Load

Harmonic Output characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Order			16		
Type	Even, Odd, All				

Output Characteristics

Parameter	Min.	Typ.	Max.	Unit	Condition
Range (Note 1)	2m		20	Vpp	≤20 MHz, HiZ Load
	2m		10		>20 MHz, HiZ Load
Accuracy	±(1%+1mV)				10 kHz sine, 0 V offset
Amplitude flatness	-0.3		+0.3	dB	50 Ω, 2.5Vpp, compare to 10 kHz sine
Output impedance		50		Ω	10 kHz sine
Output current	-200		+200	mA	
Channel Isolation		-60		dBc	

Note 1: The specification will be divided by 2 while applied to a 50Ω load

Modulation Characteristics**AM**

Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Modulation depth	0		120	%	
Modulation frequency	1 m		1 M	Hz	While modulation source is "Internal"

FM

Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Frequency deviation	0		0.5*BW		BW is the max. output frequency Limited by frequency setting

Modulation frequency	1 m		1 M	Hz	While modulation source is "Internal"
PM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Sine, Square , Ramp, Noise, Arb				
Phase deviation	0		360	°	
Modulation frequency	1 m		1 M	Hz	While modulation source is "Internal"
ASK					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Square with 50% duty cycle				
Keying frequency	1 m		1 M	Hz	While modulation source is "Internal"
FSK					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Square with 50% duty cycle				
Keying frequency	1 m		1 M	Hz	While modulation source is "Internal"
PSK					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Modulation Source	Internal/External				
Modulating wave	Square with 50% duty cycle				
Keying frequency	1 m		1 M	Hz	While modulation source is "Internal"
PWM					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Pulse				
Modulation Source	Internal/External				
Modulating wave	Sine, Square, Ramp, Noise, Arb				
Modulation frequency	1 m		1 M	Hz	While modulation source is "Internal"
Pulse width deviation resolution	8			ns	

Burst Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Pulse, Noise, Arb				
Type	Count (1-1000000 Cycles), Infinite, Gated				
Carrier frequency	2 m		BW	Hz	BW is the max. output frequency
Phase	-360		360	°	
Internal period	1μ		1000	s	
Trigger source	Internal, External, Manual				
Gated source	Internal/External				
Trigger delay			100	s	

Sweep Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Carrier	Sine, Square, Ramp, Arb				
Sweep mode	Frequency, Amplitude				
Sweep type	Linear, Log				
Direction	Up, Down, Up_Down				
Carrier frequency	1μ		BW	Hz	BW is the max. output frequency
Sweep time	1 m		500	s	
Trigger source	Internal, External, Manual				

Frequency Counter Characteristics					
Parameter	Min.	Typ.	Max.	Unit	Condition
Function	Frequency, Period, Positive/Negative pulse width, Duty cycle				
Coupling mode	AC, DC, HF REJ				
Frequency range	100 m 10		200 M 200 M	Hz	DC coupling AC coupling
Input amplitude	0.1 Vrms 0.2 Vrms 0.1 Vrms 0.2 Vrms		±2.5 V ±2.5 V 5 Vpp 5 Vpp		DC coupling, ≤100 MHz DC coupling, >100 MHz AC coupling, ≤100 MHz AC coupling, >100 MHz
Input impedance		1M		Ω	

Reference Clock Input/Output					
Reference Clock Input					
Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency		10		MHz	
Amplitude	1.4			V _{pp}	
Input impedance	5			k Ω	AC coupling
Reference Clock Output					
Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency		10		MHz	Synchronized to internal reference clock
Amplitude	2	3.3		V _{pp}	Hiz Load
Output impedance		50		Ω	

Auxiliary In/Out Characteristics					
Trigger Input					
Parameter	Min.	Typ.	Max.	Unit	Condition
VIH	2		5.5	V	
VIL	-0.5		0.8	V	
Input impedance	100			k Ω	10 kHz sine
Pulse width	100			ns	
Response time			620	ns	
Trigger Output					
Parameter	Min.	Typ.	Max.	Unit	Condition
VOH	3.8			V	IOH=8 mA
VOL			0.44	V	IOL=8 mA
Output impedance		100		Ω	
Frequency			1	MHz	
Sync Output					
Parameter	Min.	Typ.	Max.	Unit	Condition
VOH	3.8			V	IOH=8 mA
VOL			0.44	V	IOL=8 mA
Output impedance		100		Ω	
Pulse width		100		ns	
Frequency			5	MHz	
Modulation Input					
Parameter	Min.	Typ.	Max.	Unit	Condition
Frequency	0		50	kHz	
Input impedance	10			k Ω	
Amplitude@ 100% Modulation depth	11	12	13	V _{pp}	

General Characteristics					
Power					
Parameter	Min.	Typ.	Max.	Unit	Condition
Voltage	100 - 240 Vrms (± 10%), 50/60 Hz 100 - 120 Vrms (± 10%), 400 Hz				
Power consumption		25	50	W	
Display					
Parameter	Min.	Typ.	Max.	Unit	Condition
Color depth		24		Bit	
Contrast ratio		350:1			
Luminance		300		cd/m2	
Environment					
Parameter	Min.	Typ.	Max.	Unit	Condition
Operating temperature	0		40	°C	
Storage temperature	-20		60	°C	
Operating humidity	5		90	%	≤30 °C
	5		50		40 °C
Non-operating humidity	5		95	%	
Operating altitude			3048	m	≤30 °C
Non-operating altitude			15000	m	
EMC/EMI	EMC directive (2014/30/EU), IEC 61326-1:2021				
Safety	UL 61010-1:2012/R: 2018-11; CAN/CSA-C22.2 No. 61010-1:2012/A1:2018-11				
RoHS	EU 2015/863				
Calibration					
Parameter	Min.	Typ.	Max.	Unit	Condition
Calibration interval		1		year	
Mechanical					
Parameter	Min.	Typ.	Max.	Unit	Condition
Dimensions	W×H×D = 260.3mm×107.2mm×295.7mm				
Net weight		3.48		kg	
Gross weight		4.4		kg	

Ordering Information

Product Model	Description
SDG1022X Plus	25 MHz, 2 CH, 1 GSa/s, 16-bit, Sequence playback function.
SDG1032X Plus	30 MHz, 2 CH, 1 GSa/s, 16-bit, Sequence playback function.
SDG1062X Plus	60 MHz, 2 CH, 1 GSa/s, 16-bit, Sequence playback function.

Standard Configurations	Quantity
Quick Start	1
Power Cord	1
USB Cable	1
Calibration Certificate	1

Optional Configurations	Model
BNC Coaxial Cable	SDG-BNC
20 dB Attenuator	ATT-20 dB
USB-GPIB Adapter	USB-GPIB
10W Power Amplifier	SPA1010

SIGLENT is an international high-tech company, concentrating on R&D, sales, production and services of electronic test & measurement instruments.

SIGLENT first began developing digital oscilloscopes independently in 2002. After more than a decade of continuous development, SIGLENT has extended its product line to include digital oscilloscopes, isolated handheld oscilloscopes, function/arbitrary waveform generators, RF/MW signal generators, spectrum analyzers, vector network analyzers, digital multimeters, DC power supplies, electronic loads and other general purpose test instrumentation. Since its first oscilloscope was launched in 2005, SIGLENT has become the fastest growing manufacturer of digital oscilloscopes. We firmly believe that today SIGLENT is the best value in electronic test & measurement.

Group	Believe current government is responsible (%)
Total	68
Rep/Lean Rep	72
Dem/Lean Dem	64

[REDACTED]

RIGOL

MSO5000

Series Digital Oscilloscope

- Analog bandwidth: 350 MHz, 200 MHz, 100 MHz, and 70 MHz; bandwidth upgrade option supported
- 2 or 4 analog channels (upgradable), standard 16 digital channels(LA probe required)
- Up to 8 GSa/s real-time sample rate
- Up to 200 Mpts memory depth (option)
- High waveform capture rate (over 500,000 wfm/s)
- Auto measurement of 41 waveform parameters; full-memory hardware measurement function
- A variety of serial protocol triggers and decodes
- Up to 450,000 frames of hardware real-time and ceaseless waveforms recording and playback functions
- Independent search, navigation keys, and event table
- Built-in advanced power analysis software (option)
- Bode plot for loop test analysis
- Integrates 7 independent instruments into 1, including a digital oscilloscope, a logic analyzer, a spectrum analyzer, an arbitrary waveform generator, a digital voltmeter, a frequency counter and totalizer, and a protocol analyzer
- 9-inch capacitive multi-touch screen, 256-level intensity grading display, with color persistence
- Multiple interfaces available: USB HOST&DEVICE, LAN(LXI), HDMI, TRIG OUT, and USB-GPIB
- Web Control remote command
- Unique online version upgrade
- Novel and delicate industrial design, easy to operate

MSO5000 series digital oscilloscope is a high-performance oscilloscope model designed based on RIGOL UltraVision II technology. With a 9-inch capacitive multi-touch screen, the MSO5000 series integrates 7 independent instruments into one, delivering super sample bandwidth ratio, extremely high memory depth, and other excellent specifications. It is compact and portable in design, and all of the MSO series products support multiple channels, bandwidths, and the upgrade of the analysis software. As it integrates many functions of multiple instruments, different user groups can have more choices in selecting their desired product based on their needs, helping them save their budget to a large extent while enjoying the superior test support and user experience.

MSO5000 Series Digital Oscilloscope

UltraVision II Technology Platform Brings Excellent Specifications

The UltraVision II platform integrates RIGOL's latest research achievements in the digital oscilloscope's signal processing, data analysis, and waveform visualization, with higher waveform capture rate, full digital trigger technology, and full memory hardware measurement technology. The MSO5000 series digital oscilloscope is equipped with the UltraVision II technical platform, and also integrates 7 general instruments in the electronics measurement industry, offering extraordinary user experience at an unprecedented price point.

- High sample rate (maximum sample rate: 8 GSa/s)
- High memory depth (maximum memory depth of 200 Mpts, optional)
- High waveform capture rate (over 500,000 waveforms per second)
- Real-time waveform recording and playback functions (up to 450,000 frames)
- Full memory hardware measurement technology
- Full digital trigger technology

dedicated ASIC chipset, which makes the front-end circuit enjoy a higher integration, the circuit design more simple and reliable. Meanwhile, no relay is added to the MSO5000 series, which has prolonged the service life of the oscilloscope to a large extent, indirectly reducing the usage cost for users and further highlighting its cost-effective advantage.



Available for Software Upgrade with Options According to User's Demands

Want more functions within your limited budget? The MSO5000 series suffices! It has been fully configured with 4 analog channels, hardware analog bandwidth, 16-channel logic analyzer and dual-channel AWG hardware circuit before leaving the factory. If you have more demands in the future, purchase the desired option for expansion through relevant channels. Only a license code is enough. So easy!



- **Standard 4 analog channels in hardware**

The MSO5XX2 model can be upgraded to 4-CH at any time. The model remains unchanged.

- **Supports the highest analog bandwidth in hardware**

Any MSO5000 low bandwidth model can be upgraded to higher bandwidth at any time. The model remains unchanged. For example, the MSO5072 can be upgraded to 350 MHz bandwidth.

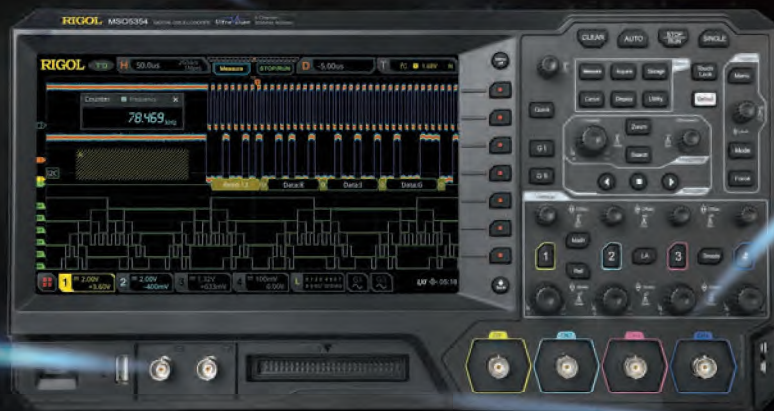
- **Standard logic analyzer interface in hardware**

Any MSO5000 standard with 16-CH logic analyzer interface and function software, and only a PLA2216 probe is required to be ordered.

- **Standard AWG output port in hardware**

Any MSO5000 standard with 2-CH arbitrary waveform generator output port, and only AWG software is required to be ordered.

4 Channel
350MHz 8GSa/s



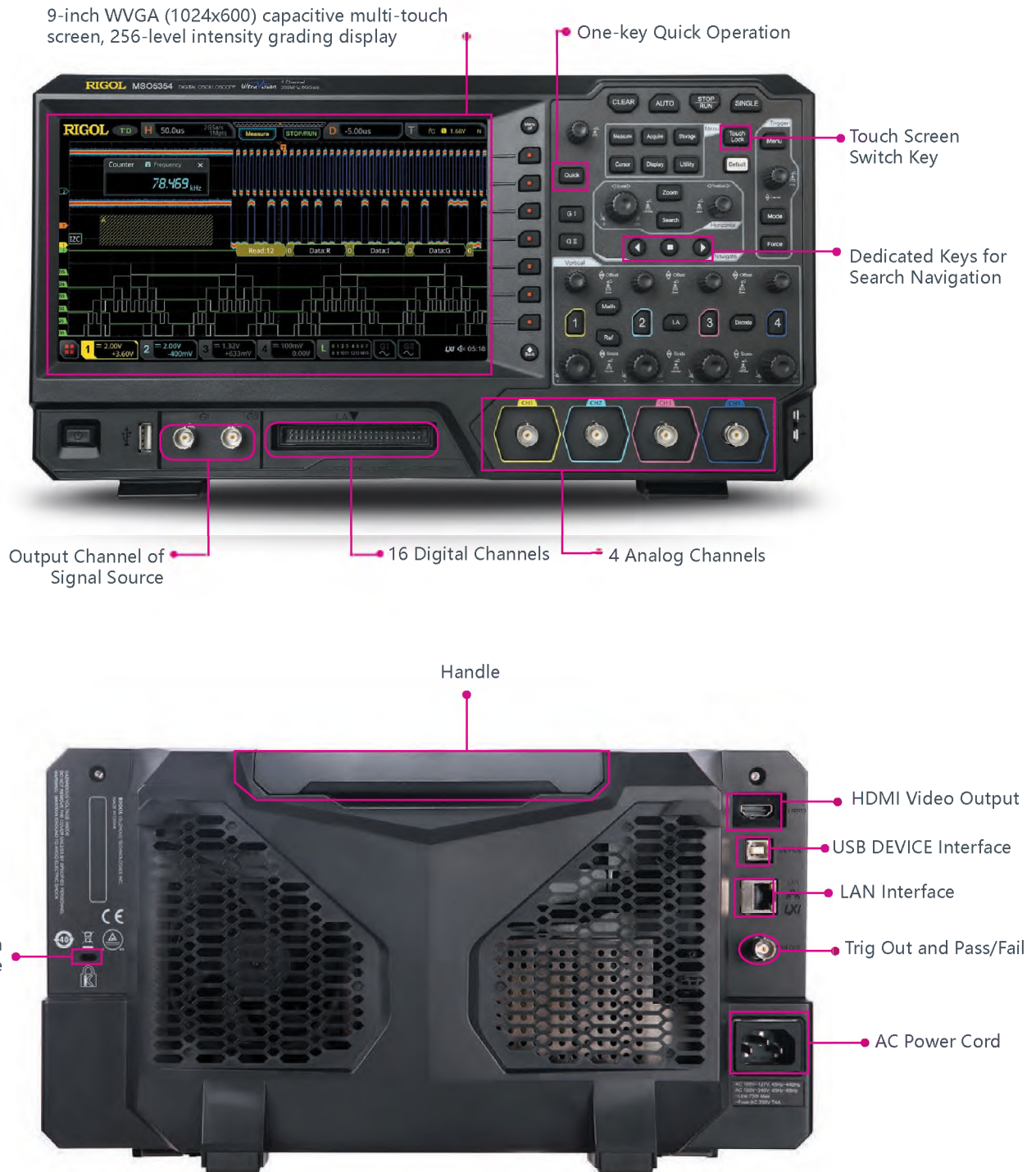
Mainstream Touch Screen Design Offers You Supreme User-friendly Experience

The 9-inch capacitive multi-touch screen supports various touch gestures, making it always keep up with the mainstream development trend for screen operation. Various multi-touch gestures such as Tap, Drag, Pinch & Stretch, and Rectangle Drawing are supported, making the measurement actions more smooth, convenient, and easy for users to operate. Meanwhile, the MSO5000 series digital oscilloscope still keeps the knob and key operation as what RIGOL traditional digital oscilloscopes have, optimizing the user-friendly interactive experience to a large extent.



► Small Body, Big Use

The innovative physical appearance of the instrument and the thin design in both sides of the instrument not only make its LCD display prominent but also keeps its shape delicate, making it portable and easy to operate.



► Overview of RIGOL's Medium-end Series Products



	MSO/DS2000A	MSO/DS4000	MSO5000	DS6000	MSO/DS7000
Analog Channel+Digital Channel	2+16	4+16	2/4+16	4	4+16
Analog Bandwidth	70 MHz to 300 MHz	100 MHz to 500 MHz	70 MHz to 350 MHz	600 MHz to 1 GHz	100 MHz to 500 MHz
Max. Sample Rate	2 GSa/s	4 GSa/s	8 GSa/s	5 GSa/s	10 GSa/s
Max. Memory Depth	56 Mpts (optional)	140 Mpts	200 Mpts (optional)	140 Mpts	500 Mpts (optional)
Waveform Capture Rate	> 52,000 wfms/s	> 110,000 wfms/s	>500,000 wfms/s	> 180,000 wfms/s	> 600,000 wfms/s
Max. Frames of Waveform Recording	65,000	200,000	450,000	200,000	450,000
LCD	8"	9"	9" capacitive multi-touch screen	10.1"	10.1" capacitive multi-touch screen
Hardware Mask Test	Standard	Standard	Standard	Standard	Standard
Built-in Arbitrary Waveform Generator	2 CH, 25 MHz (optional)	None	2 CH, 25 MHz (optional)	None	2 CH, 25 MHz (optional)
Built-in Digital Voltmeter	None	None	Standard	None	Standard
Built-in Hardware Counter	6-digit frequency counter	6-digit frequency counter	6-digit frequency counter + totalizer	6-digit frequency counter	6-digit frequency counter + totalizer
Search and Navigation	None	None	Standard, supporting table display	None	Standard, supporting table display
Power Analysis	PC (optional)	PC (optional)	Built-in UPA (optional)	PC (optional)	Built-in UPA (optional)
Serial Protocol Analysis	RS232/UART, I2C, SPI, CAN, and USB	RS232/UART, I2C, SPI, CAN, FlexRay, and MIL-STD-1553	RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, and MIL-STD-1553	RS232/UART, I2C, SPI, CAN, and FlexRay	RS232/UART, I2C, SPI, CAN, LIN, FlexRay, I2S, and MIL-STD-1553
Waveform Color Persistence	None	None	Standard	None	Standard
Histogram	None	None	Standard	None	Standard
FFT	Standard	Standard	Enhanced FFT, Standard	Standard	Enhanced FFT, Standard
MATH	Displays 1 function at the same time	Displays 1 function at the same time	Displays 4 functions at the same time	Displays 1 functions at the same time	Displays 4 functions at the same time
Connectivity	standard: USB, LAN, and VGA option: USB-GPIB	standard: USB, LAN, and VGA option: USB-GPIB	standard: USB, LAN, and HDMI option: USB-GPIB	standard: USB, VGA, and LAN option: USB-GPIB	standard: USB, LAN, and HDMI option: USB-GPIB

Design Features

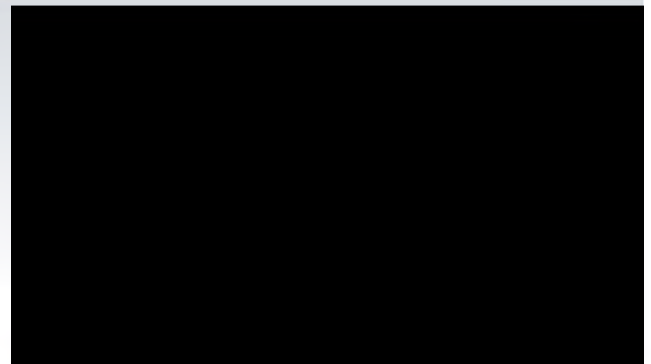
►7–into–1 Integrated Digital Oscilloscope



In today's integrated design field, a highly integrated comprehensive digital oscilloscope has become a useful tool for design engineers. The MSO5000 series digital oscilloscope launched by RIGOL this time integrates 7 independent instruments into 1, including one digital oscilloscope, one 16–channel logic analyzer, one spectrum analyzer, one arbitrary waveform generator, one digital voltmeter, one high–precision frequency counter and totalizer, and one protocol analyzer. The MSO5000 series offers you a flexible and economical solution to address your actual needs.

1. Digital Oscilloscope

- Four bandwidth models: 350 MHz, 200 MHz, 100 MHz, and 70 MHz; with the bandwidth upgradeable
- Up to 8 GSa/s real–time sample rate
- 2 or 4 analog channels (upgradeable), 16 digital channels (standard)
- Up to 200 Mpts memory depth (option)
- Maximum waveform capture rate of 500,000 wfms/s
- 350 MHz passive voltage probe for each channel (standard)



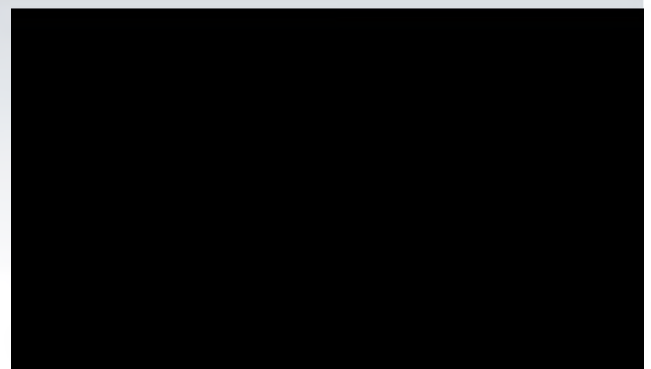
2. Logic Analyzer

- Standard 16 digital channels, just buy a PLA2216 active logic probe
- 25 Mpts memory depth for the waveforms of all the digital channels
- Up to 1 GSa/s sample rate
- Hardware real–time waveform recording and playback functions supported
- Mixed (analog channel and digital channel) trigger and decode supported
- Convenient digital channel grouping and group operation



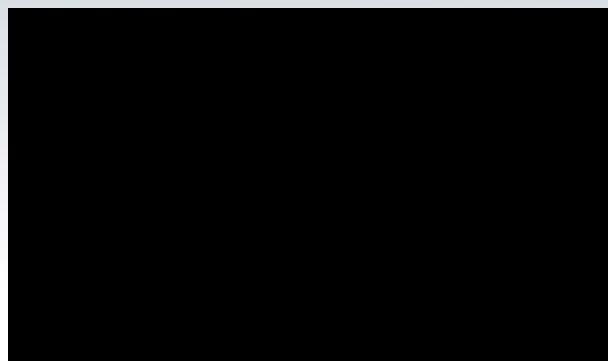
3. Spectrum Analyzer

- Standard configuration of enhanced FFT, real–time operation for max. 1 Mpts waveform data
- Max. frequency range: oscilloscope analog bandwidth
- Up to 4 groups of operations can be displayed at the same time
- Independent FFT color persistence view supported
- Up to 15 peaks available for the peak search function; event table available to be exported



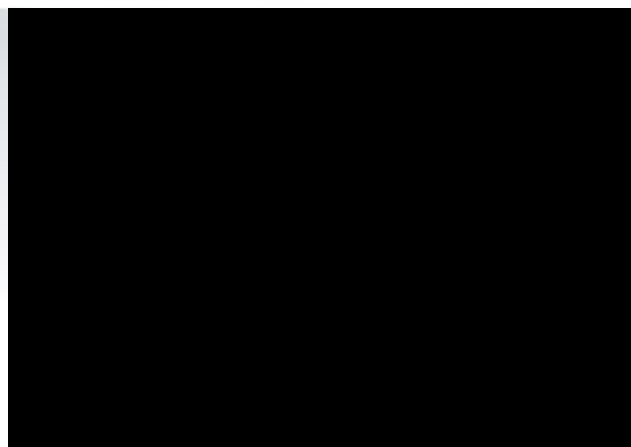
4.Arbitrary Waveform Generator (Option)

- Standard configuration of 2 waveforms output channels for the hardware, and only AWG option is required to be ordered
- 13 pre-defined waveforms
- Up to 25 MHz frequency
- Up to 200 MSa/s sample rate
- Advanced modulation, sweep, and burst signal output supported



5.Digital Voltmeter

- 3-digit DC/AC, RMS/AC+DC RMS voltage measurement
- Sound an alarm for reaching or exceeding the limits
- Display the latest measurement results in the form of a diagram, and display the extrema over the last 3 seconds



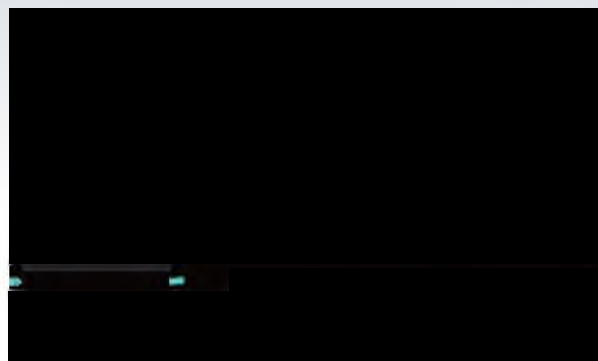
6.High-precision Frequency Counter and Totalizer

- 3 to 6-digit (selectable) high-precision frequency counter
- Support the statistics on the maximum and minimum values of the frequency
- 48-bit totalizer (standard)



7.Protocol Analyzer (Option)

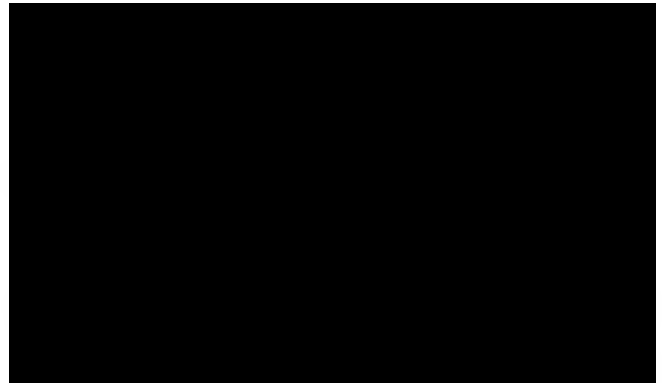
- Support RS232/UART, I2C, SPI, CAN, LIN, I2S, FlexRay, and MIL-STD-1553 serial bus



► Super High Sample Bandwidth Ratio

Bandwidth and the sample rate are two key technical specifications that engineers take priority in choosing the digital oscilloscope. Bandwidth determines the maximum frequency that the oscilloscope can acquire. The higher the bandwidth of the oscilloscope, the better the oscilloscope can keep the steep, fast, abundant harmonics components and energies of the signal under test. Whereas the sample rate determines the time interval of the sample points, that is, determines the refinement of the outlined waveforms. The MSO5000 series provides a maximum of 8 GSa/s real-time sample rate and 23X sample rate/bandwidth ratio for 350 MHz bandwidth, which makes itself far ahead of the same level products.

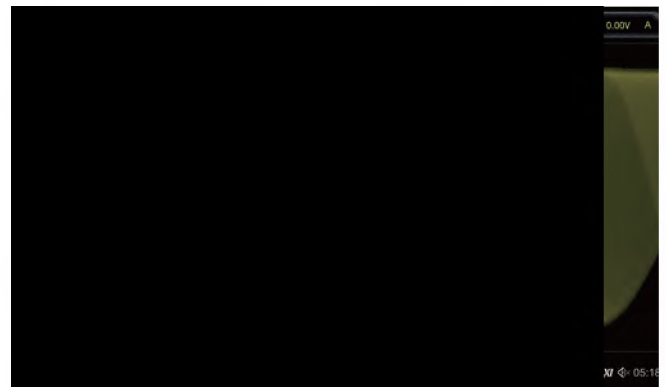
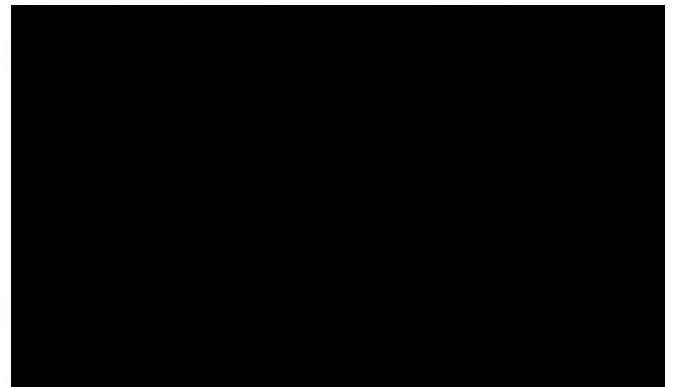
While maintaining the super high sample rate of 8 GSa/s, the MSO5000 series also has a maximum of 200 Mpts memory depth, enabling itself to capture more events in one acquisition. This provides sufficient time for users to observe while retaining the waveform details to a large extent. Thus, users can not only get the detailed information about the waveforms, but also can take an overview of the waveforms.



► 500,000 wfms/s Capture

Engineers often have to spend a lot of time and efforts in locating the problem in design and debugging. Therefore, a proper debugging tool will help engineers to work more efficiently. MSO5000 series digital oscilloscope can provide the waveform capture rate of up to 500,000 wfms/s, so that the glitches and infrequent events in waveforms can be quickly identified, greatly improving the debugging efficiency for the engineers.

256-level intensity grading display can reflect the occurrence frequencies of the infrequent events. Its newly added color persistence function can highlight the signal of different probabilities with a different color grading. You can set the persistence time to control the duration time for the waveforms to be displayed on the screen, so that the display capability of the infrequent events can be further enhanced.

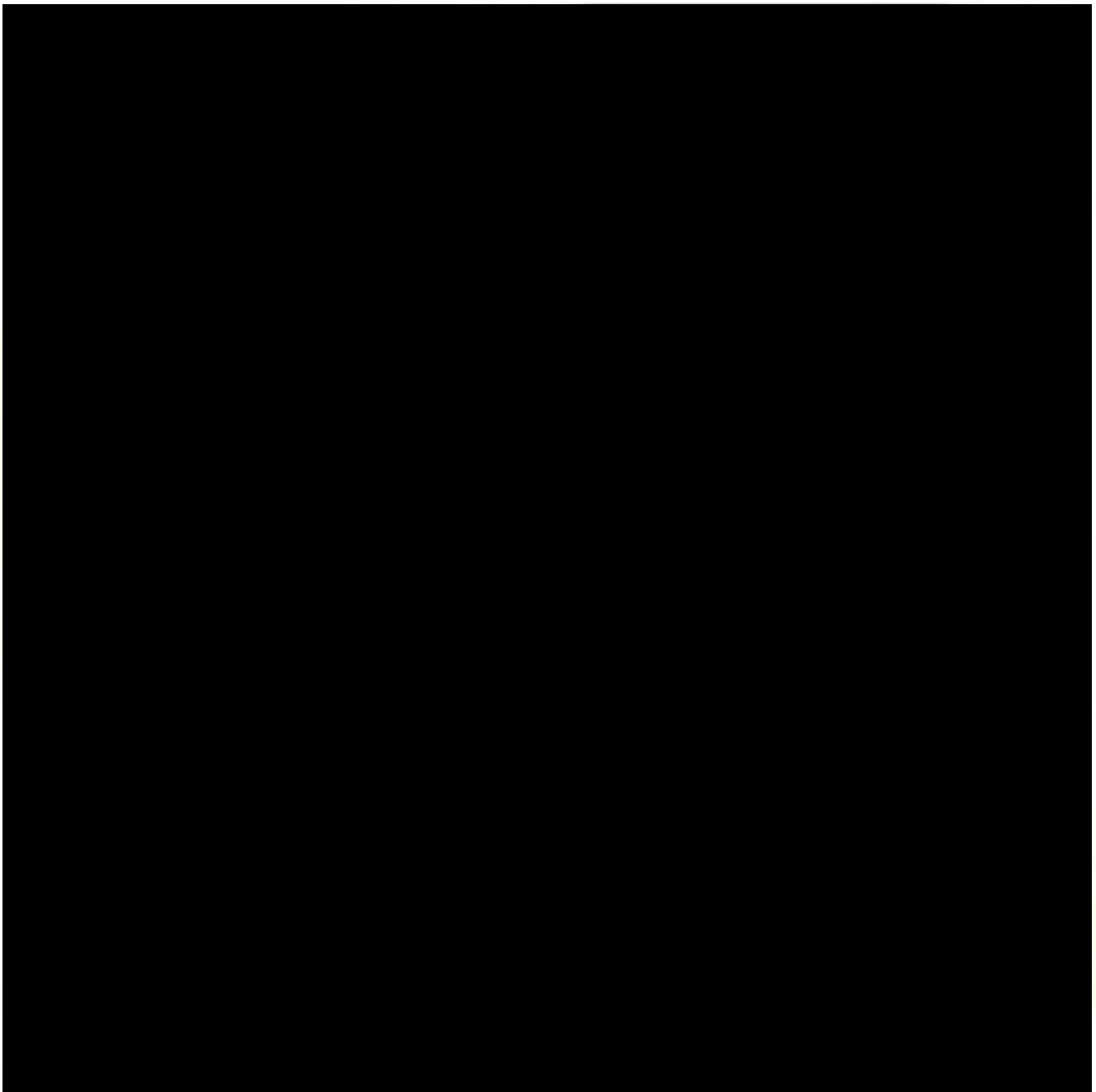


► Hardware Full Memory Auto Measurement

► Hardware Waveform Recording and Playback

The memory depth is one of the key specifications of the oscilloscope. However, whatever high the memory depth, it cannot be guaranteed that all the signals that users are concerned about can be captured in one time. This is especially true for the occurrence of the infrequent signals during debugging design or locating specific events from the long captured complicated signals. In addition, the long memory depth will be bound to reduce the response time for the oscilloscope. The hardware waveform recording and playback function can address this issue.

The MSO5000 series provides ceaseless recording and playback for a maximum of 450,000 frames of hardware real-time waveforms. This specification is second to none in the industry. The hardware waveform recording function adopts the segmented storage technology. With the technology, you can set the trigger conditions to make a selective choice in capturing and saving the signals that you are interested in, then mark the time on the signal. This has not only ensured the high capture efficiency, but also prolonged the overall observation time for the waveforms. The hardware waveform playback function enables you to have sufficient time to take a careful view and analysis of



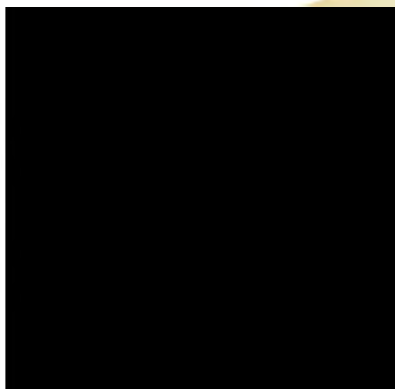
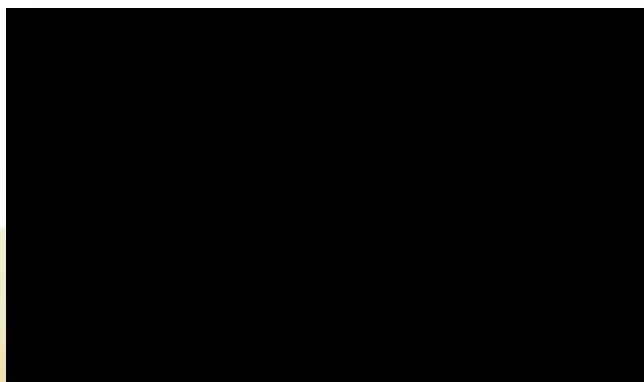
► Hardware Pass/Fail Test

The MSO5000 series is equipped with hardware pass/fail test function as the standard configuration, which can be used in signal monitoring for a long time, signal monitoring during design, and signal test in the production line. You can set the test mask based on the known "standard" waveform, and then compare the signal under test with the "standard" waveform to display the statistics on the test results. When a successful or failed test is detected by the oscilloscope, you can choose to immediately stop monitoring, enable the beeper to sound an alarm, or save the current screen image. Also, you can choose to continue monitoring.



► Enhanced FFT Analysis

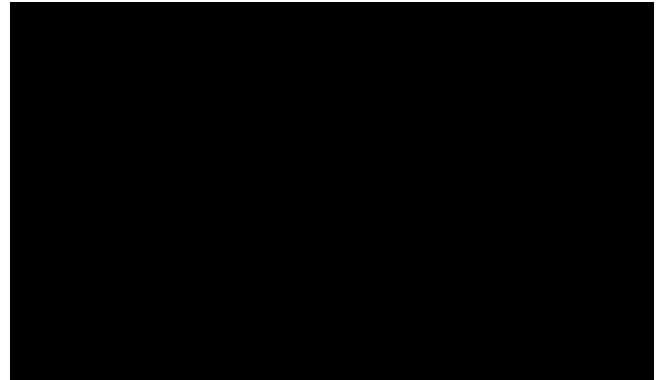
The MSO5000 series can analyze 1 Mpts of FFT, which improves the frequency resolution to a large extent, convenient for you to better analyze the disturbance noise in the circuit under test. To adjust the spectrum waveforms to be observed, set the center frequency and the span; or set the start frequency and the stop frequency. The MSO5000 series also provides the peak search function, which can auto mark up to 15 peaks and display their frequencies and amplitudes in the form of a list. Such information and the non-peak section in the frequency-domain cursor measurement can greatly improve the working efficiency of the engineers.



► A Variety of Triggers and Protocol Decodings

MSO5000 series digital oscilloscope provides powerful trigger functions, including Edge trigger, Pulse trigger, Slope trigger, Video trigger, Pattern trigger, Duration trigger, Timeout trigger, Runt trigger, Window trigger, Delay trigger, Setup/Hold trigger, Nth Edge trigger, and serial protocol trigger. These triggers can help engineers accurately and quickly capture and identify the signals of great interest.

The optional serial protocol decoding is capable of decoding 4 serial buses simultaneously. The full memory data analysis and the decoding event table display can help engineers quickly find out the system failure and locate the symbol error waveforms, greatly improving the debugging efficiency of the overall system signals. The MSO5000 series also provides optional decodings such as RS232/UART, I2C, SPI, CAN, LIN, I2S, FlexRay, and MIL-STD-1553. These serial bus decodings can help engineers make a deep analysis on the waveforms, and they are widely applied to the auto electronics, aerospace, and other fields. Besides, the oscilloscope has a standard parallel bus decoding, which is capable of performing the debugging test for the mixed signals of up to 20 channels (analog channel and digital channel) simultaneously.



► Zone Trigger

In face of the complex and variable circuit signal in the circuit debugging, it is easy for us to find the transient occasional exception signals on the oscilloscope with a high waveform capture rate. However, it is not easy to isolate the exceptional signal from the complex circuit signals and trigger them stably. You have to spend more time on the usage of some advanced trigger types, and sometimes even the powerful advanced trigger is unable to make it. The MSO5000 series is specially equipped with touch screen-based zone trigger function, which can help users accelerate the signal isolation process. The zone trigger function is easy to operate. You only need to use the specified rectangle drawing gesture to draw one or two rectangular zones on the corresponding signal section, then you can quickly isolate the signal for observation. The zone trigger can work with other 20 trigger types, and it also supports the decoding, waveform recording, and pass/fail test functions. This is conducive to the debugging of the complex signals.



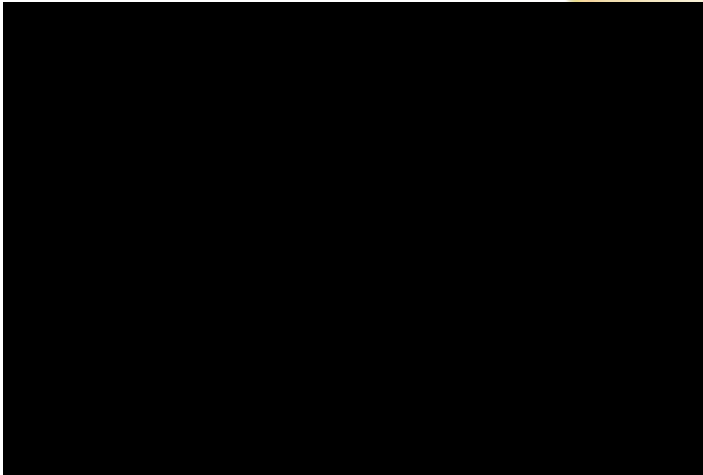
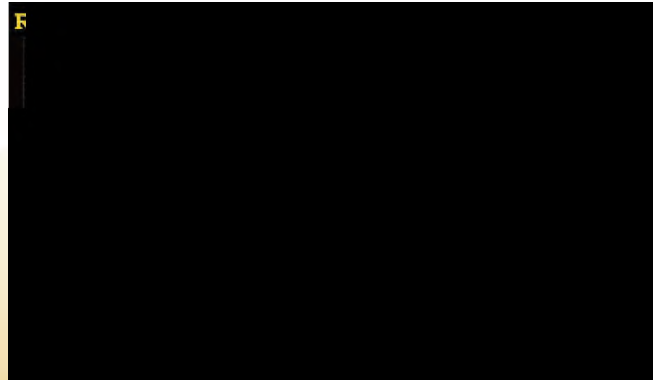
Draw a rectangle on the transient exception signal and select Trigger zone B.



Quickly isolate the exceptional signal with Edge trigger and Zone trigger.

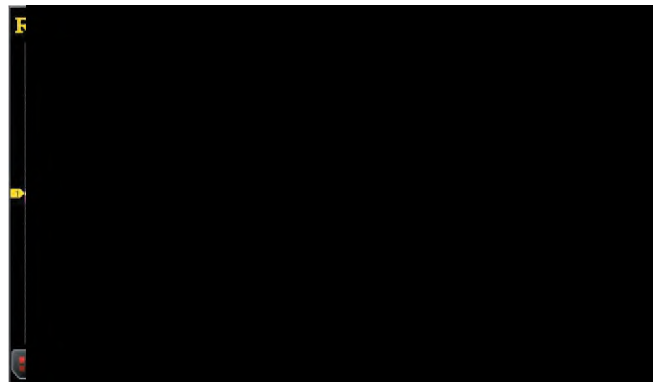
► Power Analysis (Option)

To cater to the increasing test demand for the switch power supply and the power component, we configure the MSO5000 series with the optional built-in power analysis software. The current power analysis software can complete the power quality analysis and ripple analysis. The power analysis software can help engineers analyze the commonly used power parameters rapidly and accurately, without needing to make tedious configurations manually or do complicated formula calculation.



► Bode Plot

The stability of the switch power supply affects the reliability of the whole system. MSO5000 series can generate the sweep signal of the specified range by controlling the built-in signal generator module and output the signal to the switch power supply to carry out loop analysis test. The bode plot generated from the test can display the gain and phase variations of the system under different frequencies, enabling engineers to get a clear view about data from the bode plot. By analyzing the phase margin (PM), gain margin (GM), and other parameters, they can judge whether the system is stable.

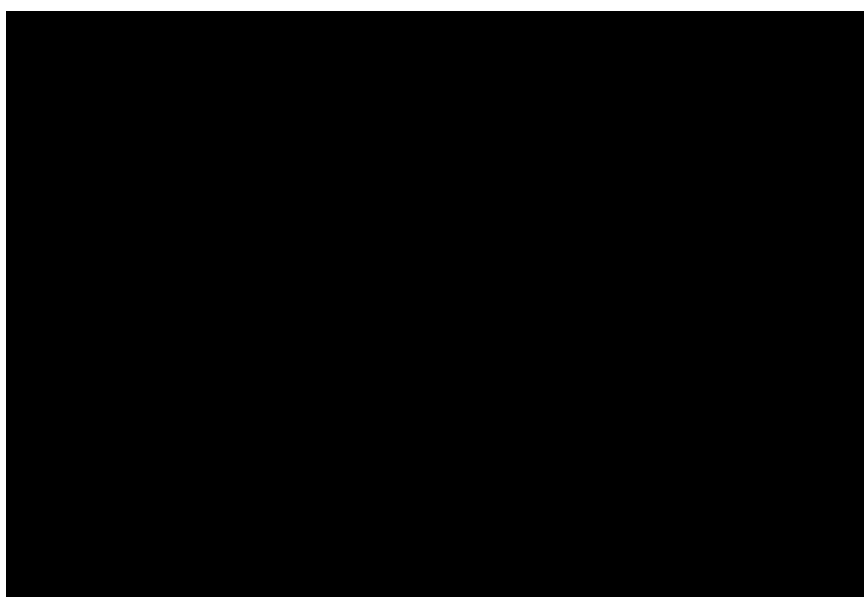


► Remote Control Software

The Web Control software is a standard configuration for the MSO5000 series. You can use the software to migrate the instrument control and waveform analysis to the PC, and then click the mouse to operate easily.

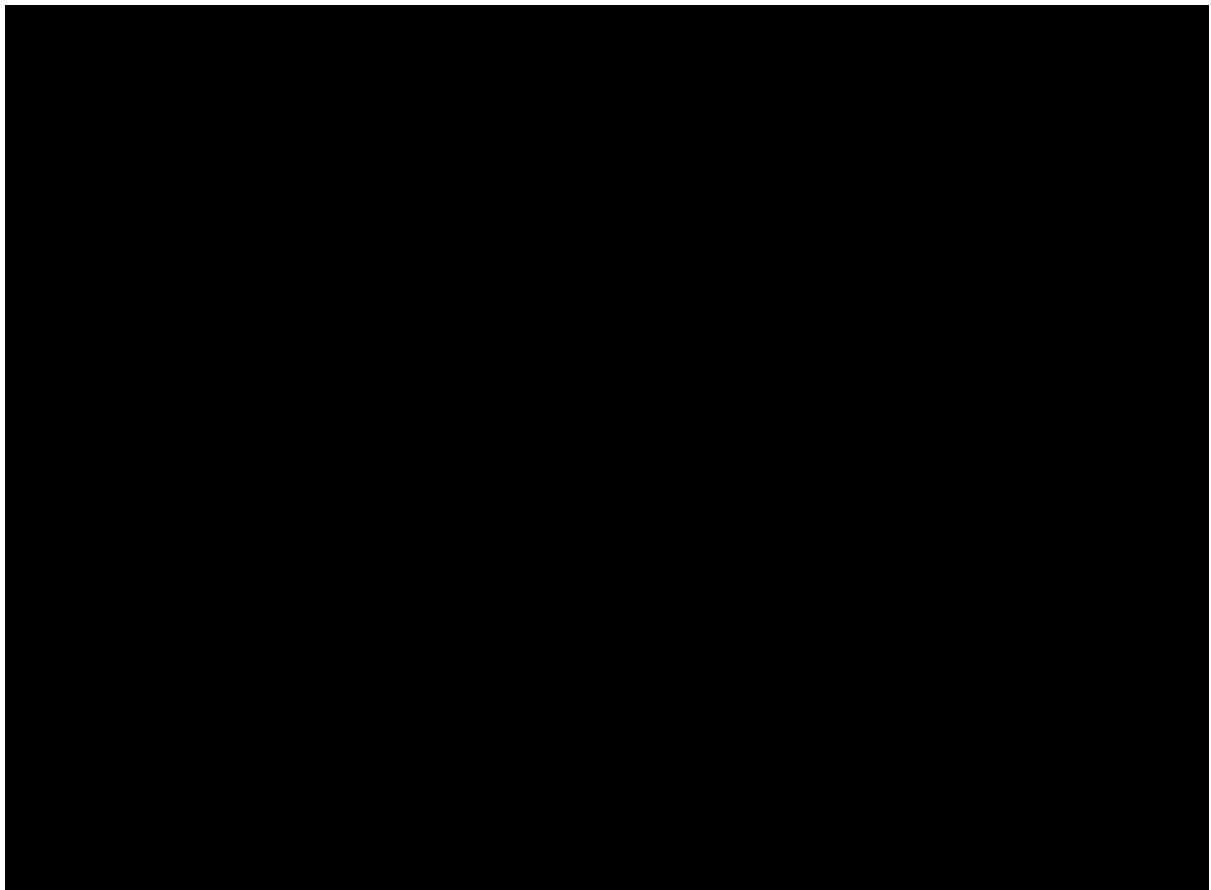
You only need to input the IP address of the oscilloscope into the address bar of the Web browser to open the Web Control software. The display of the waveform interface and instrument

control in the software are consistent with that in the MSO5000 series. You can use the mouse to tap the keys or knobs in the Web Control interface to complete the waveform control, measurement, and analysis. In the Web Control interface, the basic information of the instrument is displayed, and you can also upload or download the files of the oscilloscope, control with the SCPI commands, set or modify the network status.



► User-defined One-key Quick Operation

There is a dedicated Quick key on the front panel of the MSO5000 series, enabling you to customize the function of the key and complete the commonly used operation quickly. With the customized setting of the Quick key, you can quickly capture the screen image, realize waveform saving, setup saving, all measurement, reset measurement statistics, reset pass/fail test statistics, printing, email sending, waveform recording, group saving, and etc.



RIGOL Probes and Accessories Supported by the MSO5000 Series

• RIGOL Passive Probes

Model	Type	Description	Model	Type	Description
 PVP2150	High-impedance Probe	1X: DC ~ 35 MHz 10X: DC ~ 150 MHz Compatibility: All models of RIGOL 's digital oscilloscopes	 RP1010H	High-voltage Probe	DC ~ 40 MHz DC: 0 ~ 10 kV DC AC: pulse ≤ 20 kVp-p AC: sine wave ≤ 7 kVrms Compatibility: All models of RIGOL 's digital oscilloscopes
 PVP2350	High-impedance Probe	1X: DC ~ 35 MHz 10X: DC ~ 350 MHz Compatibility: All models of RIGOL 's digital oscilloscopes	 RP1018H	High-voltage Probe	DC ~ 150 MHz DC+AC Peak: 18 kV CAT II AC RMS: 12 kV CAT II Compatibility: All models of RIGOL 's digital oscilloscopes
 RP3500A	High-impedance Probe	DC ~ 500 MHz Compatibility: All models of RIGOL 's digital oscilloscopes			
 RP1300H	High-voltage Probe	DC ~ 300 MHz CAT I 2000 V (DC+AC) CAT II 1500 V (DC+AC) Compatibility: All models of RIGOL 's digital oscilloscopes			

• RIGOL Active and Current Probes

Model	Type	Description	Model	Type	Description
 RP1001C	Current Probe	BW: DC ~ 300 kHz Maximum Input DC: ± 100 A AC P-P: 200 A AC RMS: 70 A Compatibility: All models of RIGOL 's digital oscilloscopes	 RP1000P	Power Supply	Power supply for RP1003C, RP1004C, and RP1005C; supporting 4 channels.
 RP1002C	Current Probe	BW: DC ~ 1 MHz Maximum Input DC: ± 70 A AC P-P: 140 A AC RMS: 50 A Compatibility: All models of RIGOL 's digital oscilloscopes	 RP1025D	High-voltage Differential Probe	BW: 25 MHz Max. voltage ≤ 1400 Vpp Compatibility: All models of RIGOL 's digital oscilloscopes
 RP1003C	Current Probe	BW: DC ~ 50 MHz Maximum Input AC P-P: 50 A (noncontinuous) AC RMS: 30 A Compatibility: All models of RIGOL 's digital oscilloscopes Required to order RP1000P power supply.	 RP1050D	High-voltage Differential Probe	BW: 50 MHz Max. voltage ≤ 7000 Vpp Compatibility: All models of RIGOL 's digital oscilloscopes
 RP1004C	Current Probe	BW: DC ~ 100 MHz Maximum Input AC P-P: 50 A (noncontinuous) AC RMS: 30 A Compatibility: All models of RIGOL 's digital oscilloscopes Required to order RP1000P power supply.	 RP1100D	High-voltage Differential Probe	BW: 100 MHz Max. voltage ≤ 7000 Vpp Compatibility: All models of RIGOL 's digital oscilloscopes
 RP1005C	Current Probe	BW: DC ~ 10 MHz Maximum Input AC P-P: 300 A (noncontinuous), 500 A (@pulse width ≤ 30 us) AC RMS: 150 A Compatibility: All models of RIGOL 's digital oscilloscopes Required to order RP1000P power supply.	 PLA2216	Active Logic Probe	Active logic probe (dedicated probe for MSO5000 series)

All the specifications are guaranteed except the parameters marked with "Typical" and the oscilloscope needs to operate for more than 30 minutes under the specified operation temperature.

Model	MSO5072	MSO5074	MSO5102	MSO5104	MSO5204	MSO5354
Analog Bandwidth	70 MHz	70 MHz	100 MHz	100 MHz	200 MHz	350 MHz
Rising Time (typical)	≤5 ns	≤5 ns	≤3.5 ns	≤3.5 ns	≤1.75 ns	≤1 ns
	2	4	2	4	4	4
No. of Input/Output Channels	16 input digital channels (PLA2216 probe option is required to be ordered) Dual-channel arbitrary waveform generator output (required to install the MSO5000-AWG option to activate the software function)					
Sampling Mode	Real-time sampling					
Max. Sample Rate of Analog Channel	MSO5354/MSO5204/MSO5104/MSO5074: 8 GSa/s (single-channel), 4 GSa/s (half-channel ^[1]), 2 GSa/s (all channels) MSO5102/MSO5072: 8 GSa/s (single-channel), 2 GSa/s (all channels)					
Max. Memory Depth	2RL(option)	Analog channel: 200 Mpts (single-channel), 100 Mpts (half-channel ^[1]), 50 Mpts (all channels) Digital channel: 25 Mpts (all channels)				
Max. Waveform Capture Rate ^[2]	≥500,000 wfms/s					
Hardware Real-time Waveform Recording and Playing	≥450,000 wfms (single-channel)					
Peak Detection	Under all the time base settings, capture 500 ps glitches					
LCD Size and Type	9-inch capacitive multi-touch screen/gesture enabled operation					
Display Resolution	1024 × 600					

Vertical System Analog Channel

Vertical System Analog Channel	
Input Coupling	DC, AC or GND
Input Impedance	1 MΩ ± 1%
Input Capacitance	17 pF ± 3 pF
Probe Attenuation Coefficient	0.0001X, 0.0002X, 0.0005X, 0.001X, 0.002X, 0.005X, 0.01X, 0.02X, 0.05X, 0.1X, 0.2X, 0.5X, 1X, 2X, 5X, 10X, 20X, 50X, 100X, 200X, 500X, 1000X, 2000X, 5000X, 10000X, 20000X, and 50000X
Maximum Input Voltage	CAT I 300 Vrms, 400 Vpk, Transient Overvoltage 1600 Vpk
Vertical Resolution	8 bits
Vertical Sensitivity Range ^[3]	500 μV/div~10 V/div
Offset Range	± 1 V (500 μV/div~50 mV/div) ± 30 V (51 mV/div~260 mV/div) ± 100 V (265 mV/div~10 V/div)
Dynamic Range	± 5 div (8 bits)
Bandwidth Limit (Typical)	20 MHz, 100 MHz, 200 MHz; selectable for each channel
DC Gain Accuracy ^[3]	± 3% of full scale
DC Offset Accuracy	<200 mV/div (± 0.1 div ± 2 mV ± 1.5% of offset value) >200 mV/div (± 0.1 div ± 2 mV ± 1.0% of offset value)
Channel-to-Channel Isolation	40 dB, from DC to maximum rated bandwidth of each model
ESD Tolerance	± 8 kV (on input BNCs)

Vertical System Digital Channel

Vertical System Digital Channel	
Number of Channels	16 input channels (D0~D15) (D0~D7, D8~D15)
Threshold Range	± 15.0 V, in 10 mV step
Threshold Accuracy	± (100 mV + 3% of the threshold setting)
Threshold Selection	TTL(1.4 V), COMS5.0(2.5 V), COMS3.3(1.65 V), COMS2.5(1.25 V), COMS1.8(0.9 V), ECL(-1.3 V), PECL(3.7 V), LVDS(1.2 V), 0.0 V User (adjustable threshold for 8 channels in a group)
Max. Input Voltage	± 40 V peak CAT I; transient overvoltage 800 Vpk
Max. Input Dynamic Range	± 10 V + threshold
Minimum Voltage Swing	500 mVpp

Input Impedance	About 101 k Ω
Probe Load	$\approx$ 8 pF
Vertical Resolution	1 bit

Horizontal System--Analog Channel

Horizontal System--Analog Channel					
		70 MHz	100 MHz	200 MHz	350 MHz
Range of Time Base		5 ns/div~1 ks/div	5 ns/div~1 ks/div	2 ns/div~1 ks/div	1 ns/div~1 ks/div
		Support fine adjustment			
Time Base Resolution		10 ps			
Time Base Accuracy		± 10 ppm ± 10 ppm/year			
Time Base Delay Range	before triggering	≥ 1/2 screen width			
	after triggering	1 s or 100 div, whichever is greater			
Time Interval (ΔT) Measurement		± (1 sample interval) ± (2 ppm × readout) ± 50 ps			
Inter-channel Offset Correction Range		± 100 ns			
Horizontal Mode	YT	Default			
	XY	X = Channel 1, Y = Channel 2			
	SCAN	Time base ≥ 200 ms/div, available to enter or exit the SCAN mode by rotating the Horizontal SCALE knob			
	ROLL	Time base ≥ 200 ms/div, available to enter or exit the ROLL mode by rotating the Horizontal SCALE knob (enable the auto ROLL mode at first)			

Horizontal System--Digital Channel

Horizontal System--Digital Channel	
Min. Detectable Pulse Width	5 ns
Maximum Input Frequency	200 MHz (accurately copied as the sine wave of the maximum frequency of the logic square wave; input amplitude is the minimum swing; the shortest the ground cable is required for the logic probe)
Inter-channel Time Delay	2 ns (typical), 5 ns (maximum)

Acquisition System

Acquisition System		
MSO5354/MSO5204/MSO5104/MSO5074: 8 GSa/s (single-channel), 4 GSa/s (half-channel) ^[1] , 2 GSa/s (all channels) MSO5102/MSO5072: 8 GSa/s (single-channel), 2 GSa/s (all channels)		
Max. Sample Rate of Analog Channel		
Max. Memory Depth of Analog Channel	Standard	100 Mpts (single-channel), 50 Mpts (half-channel) ^[1] , 25 Mpts (all channels)
	2RL(option)	200 Mpts (single-channel), 100 Mpts (half-channel) ^[1] , 50 Mpts (all channels)
Max. Sample Rate of Digital Channel	1 GSa/s (all channels)	
Max. Memory Depth of Digital Channel	25 Mpts (all channels)	
Acquisition Mode	Normal	Default
	Peak Detection	Capture 500 ps glitches
	Average Mode	2, 4, 8, 16...65536 are available for you to choose, averaging point by point
	High Resolution	12 bits (max.)

Trigger System

Trigger System		
Trigger Source	Analog channel (1~4), digital channel (D0~D15), AC Line	
Trigger Mode	Auto, Normal, Single	
Trigger Coupling	DC	DC coupling trigger
	AC	AC coupling trigger
	High Frequency Rejection	High frequency rejection, cut-off frequency~55 kHz (internal only)
	Low Frequency Rejection	Low frequency rejection, cut-off frequency~55 kHz (internal only)
Noise Rejection	Increase delay for the trigger circuit (internal only), On/Off	
Holdoff Range	8 ns to 10 s	
Trigger Bandwidth	Analog bandwidth	
Trigger Sensitivity	1 div or 5 mVpp, whichever is larger, <10mV/div	
	0.5 div, $\geq$ 10mV/div Enable the noise rejection, with trigger sensitivity reducing half	

Trigger Level	Internal:	± 5 div from the center of the screen
Range	AC Line	Fixed 50%

Trigger Type

Trigger Type	
Zone Trigger	Trigger in the rectangle area drawn manually, supporting trigger zone A and trigger zone B. The trigger conditions can be "Intersect" or "Not intersect" Source channel: CH1~CH4; only one analog channel is triggered each time
Trigger Type	Standard: Edge trigger, Pulse trigger, Slope trigger, Video trigger, Pattern trigger, Duration trigger, Timeout trigger, Runt trigger, Window trigger, Delay trigger, Setup/Hold trigger, and Nth Edge trigger Option: RS232, UART, I2C, SPI, CAN, FlexRay, LIN, I2S, and MIL-STD-1553
Edge	Trigger on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either. Source channel: CH1~CH4, D0~D15, or AC Line
Pulse	Trigger on the positive or negative pulse with a specified width. The pulse width is greater or smaller than a certain value or within a certain time range. Source channel: CH1~CH4, D0~D15
Slope	Trigger on the positive or negative slope of the specified time (800 ps~10 s). The slew time is greater or smaller than a certain value or within a certain time range. Source channel: CH1~CH4
Video	Trigger on all lines, specified line, add field, or even field that conforms to the video standards. The supported video standards include NTSC, PAL/SECAM, 480P, 576P, 720P, 1080P, and 1080i. Source channel: CH1~CH4
Pattern	Identifies a trigger condition by searching for a specified pattern. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X, Rising, or Falling. Source channel: CH1~CH4, D0~D15
Duration	Trigger when the specified pattern meets the specified duration condition. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range. Source channel: CH1~CH4, D0~D15
Timeout	Trigger when duration of a certain event exceeds the specified time (16 ns~10 s). The event can be specified as Rising, Falling, or Either. Source channel: CH1~CH4, D0~D15
Runt	Trigger when the pulses pass through one threshold but fail to pass through another threshold. The channel only supports analog channels Source channel: CH1~CH4
Window	Trigger in a specified window state when the rising edge of the signal crosses the upper threshold or the falling edge crosses the lower threshold. The window state can be Enter, Exit, or Time. Source channel: CH1~CH4
Delay	Trigger when the time difference between the specified edges of Source A and Source B meets the preset time. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range. Source channel: CH1~CH4, D0~D15
Setup/Hold	When the setup time or hold time between the input clock signal and the data signal is smaller than the specified time (8 ns~1 s). Source channel: CH1~CH4, D0~D15
Nth Edge	Trigger on the Nth edge that appears after the specified idle time. The edge can be specified as Rising or Falling. Source channel: CH1~CH4, D0~D15
RS232/UART (Option)	MSO5000-COMP option Trigger on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s). Source channel: CH1~CH4, D0~D15
I2C (Option)	MSO5000-EMBD option Trigger on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus. Source channel: CH1~CH4, D0~D15
SPI (Option)	MSO5000-EMBD option Trigger on the specified pattern of the specified data width (4~32) of SPI bus. CS and Timeout are supported. Source channel: CH1~CH4, D0~D15
CAN (Option)	MSO5000-AUTO option Trigger on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Answer Error, Check Error, Format Error, Bit Fill, and Random of the CAN signal (up to 5Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4, D0~D15
FlexRay (Option)	MSO5000-FLEX option Trigger on the specified position (TSS End, FSS_BSS End, FES End, DTS End), frame (null, Syn, Start, All), symbol (CAS/MTS and WUS), error (Head CRC Err, Tail CRC Err, Decode Err, and Random Err) of the FlexRay signal (up to 10 Mb/s). Source channel: CH1~CH4, D0~D15
LIN (Option)	MSO5000-AUTO option Trigger on the Sync, ID, Data (length settable), Data&ID, Wakeup, Sleep, and Error of the LIN bus signal (up to 20 Mb/s). Source channel: CH1~CH4, D0~D15

I2S (Option)	MSO5000–AUDIO option Trigger on 2's complement data of audio left channel, right channel, or either channel (=, ≠, >, <, <>, ><). The available alignment modes include I2S, LJ, and RJ. Source channel: CH1~CH4, D0~D15 (only available for the MSO5XX4 model or the model installed with the MSO5000–4CH option)
MIL–STD–1553 (Option)	MSO5000–AERO option Trigger on Sync (Data Sync, Cmd/Status Sync, and All Sync), Data, RTA, RTA+11Bit, and Error (Sync Error and Check Error) of the MIL–STD–1553 bus. Source channel: CH1~CH4

Search&Navigation

Search, Navigation, and Table	
Type	Edge, Pulse, Runt, Slope, RS232, I2C, and SPI
Source	Any analog channel
Copy	Copy the search settings to the trigger settings, and copy from the trigger settings
Result Display	Event table or navigation. Go to the specific event through the event table index
Navigation	Memory playing: view the memory waveforms with the navigation keys by scrolling through stored waveform data, supporting viewing at three speeds.
	ZOOM playing: view the details of waveforms with the navigation keys by panning the ZOOM window automatically, supporting viewing at three speeds.
	Recording playback: play back the recorded waveforms with the navigation keys.
	Event navigation: use the navigation keys to scroll through the event search results.

Waveform Measurement

Waveform Measurement		
Cursor	Number of Cursors	2 pairs of XY cursors
	Manual Mode	Voltage deviation between cursors (ΔY) Time deviation between cursors (ΔX) Reciprocal of ΔX (Hz) ($1/\Delta X$)
	Track Mode	Fix Y–axis to track X–axis waveform point's voltage and time values Fix X–axis to track Y–axis waveform point's voltage and time values
	Auto Measurement	Allow to display cursors during auto measurement
	XY Mode	Measure the voltage parameters of the corresponding channel waveforms in XY time base mode. X = Channel 1, Y = Channel 2
Auto Measurement	Number of Measurements	41 auto measurements; and up to 10 measurements can be displayed at a time.
	Measurement Source	CH1~CH4, Math1~Math4, and D0~D15
	Measurement Mode	Normal and Precision (full–memory hardware measurement)
	Measurement Range	Main, Zoom, and Cursor
	All Measurement	Display 33 measurement items for the current measurement channel; the measurement results are updated continuously; you can switch the measurement channel.
	Vertical	Vmax, Vmin, Vpp, Vtop, Vbase, Vamp, Vupper, Vmid, Vlower, Vavg, VRMS, Per.VRMS, Overshoot, Preshoot, Area, Per.Area, and Std.Dev.
	Horizontal	Period, Frequency, Rise Time, Fall Time, +Width, –Width, +Duty, –Duty, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Tvmax, Tvmin, +Slew Rate, and –Slew Rate
	Others	Delay(A ↑ –B ↑), Delay(A ↑ –B ↓), Delay(A ↓ –B ↑), Delay(A ↓ –B ↓), Phase(A ↑ –B ↑), Phase(A ↑ –B ↓), Phase(A ↓ –B ↑), and Phase(A ↓ –B ↓)
	Analysis	Counter, DVM, Bode, and UPA
	Statistics	Current, Average, Max, Min, Standard Deviation, Count Statistical times settable

Waveform Calculation

Waveform Calculation	
No. of Math Functions	4; 4 math functions available to be displayed at a time
Operation	A+B, A–B, A × B, A/B, FFT, A&&B, A B, !A, Intg, Diff, Sqrt, Lg, Ln, Exp, Abs, AX+B, LowPass, HighPass, BandPass, and BandStop
Source	CH1~CH4, D0~D15 (only available for A&&B, A B, !A, and A^B), Math1~Math4, and Ref1~Ref10
Color Grade	Support Math and FFT

Enhanced FFT	Record Length	Max. 1 Mpts
	Window Type	Rectangular, Blackman–Harris, Hanning (default), Hamming, Flattop, and Triangle.
	Peak Search	A maximum of 15 peaks, confirmed by the settable threshold and offset threshold set by users

Waveform Analysis

Waveform Analysis		
Waveform Recording		Store the signal under test in segments according to the trigger events, i.g. save all the sampled waveform data as a segment to the RAM for each trigger event. The maximum number of the sampled segments reaches 450,000.
	Source	All enabled analog channels and digital channels
	Analysis	Support playing frame by frame or continuous playing; capable of calculating, measuring, and decoding the played waveforms
Pass/Fail Test		Compare the signal under test with the user-defined mask to provide the test results: the number of successful tests, failed tests, and the total number of tests. The pass/fail event can enable immediate stop, beeper, and the screenshot.
	Source	Any analog channel
Histogram		The waveform histogram provides a group of data, showing the number of times a waveform hits within the defined region range on the screen. The waveform histogram not only shows the distribution of hits, but also the ordinary measurement statistics.
	Source	Any analog channel or auto measurement item
	Type	Horizontal, Vertical, or Measure
	Measure	Sum, Peaks, Max, Min, Pk_Pk, Mean, Median, Mode, Bin width, Sigma, and XScale
Color Grade	Mode	Support all modes, except the Zoom, XY, and ROLL modes
		Provide a dimensional view for color grade waveforms
	Source	Any analog channel
	Color Theme	Temperature and intensity
	Mode	Support all modes

Serial Decoding

Serial Decoding	
Number of Decodings	4, four protocol types can be supported at the same time
Decoding Type	Standard: Parallel
	Option: RS232, UART, I2C, SPI, LIN, CAN, FlexRay, I2S, and MIL–STD–1553
Parallel	Up to 20 bits of Parallel decoding, supporting the combination of any analog channel and digital channel. Support user-defined clock and auto clock settings. Source channel: CH1~CH4, D0~D15
RS232/UART	MSO5000–COMP option Decode the RS232/UART (up to 20 Mb/s) bus's TX/RX data (5–9 bits), parity (Odd, Even, or None), and stop bits (1–2 bits) Source channel: CH1~CH4, D0~D15
I2C	MSO5000–EMBD option Decode the address (with or without the R/W bit) of the I2C bus, data, and ACK. Source channel: CH1~CH4, D0~D15
SPI	MSO5000–EMBD option Decode the MISO/MOSI data (4–32 bits) of the SPI bus. The available mode includes "Timeout" and "CS". Source channel: CH1~CH4, D0~D15
LIN	MSO5000–AUTO option Decode the protocol version (1.X or 2.X) of the LIN bus (up to 20 Mb/s). The decoding displays sync, ID, data, and check sum. Source channel: CH1~CH4, D0~D15
CAN	MSO5000–AUTO option Decode the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN bus (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1~CH4, D0~D15
FlexRay	MSO5000–FLEX option Decode the frame ID, PL (payload), Header CRC, Cycle Count, Data, Tail CRC, and DTS of the FlexRay bus (up to 10 Mb/s). The supported signal types include BP, BM, and RX/TX. Source channel: CH1~CH4, D0~D15
I2S	MSO5000–AUDIO option Decode I2S audio bus left channel data and right channel data, supporting 4–32 bits. The alignment modes include I2S, LJ, and RJ. Source channel: CH1~CH4, D0~D15 (only available for the MSO5XX4 model or the model installed with the MSO5000–4CH option)

MIL-STD-1553	MSO5000-AERO option Decode the MIL-STD-1553 bus signal's data word, command word, and status word (address+last 11 bits). Source channel: CH1~CH4
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Auto

Auto	
AutoScale	Min voltage greater than 5 mVpp, duty cycle greater than 1%, frequency over 35 Hz

Arbitrary Waveform Generator

Arbitrary Waveform Generator (technical specifications are typical values) (option)

Number of Channels	2	
Output Mode	Normal (2-channel output)	
Sample Rate	200 MSa/s	
Vertical Resolution	14 bits	
Max. Frequency	25 MHz	
Standard Waveform	Sine, Square, Ramp, Pulse, DC, Noise	
Built-in Waveform	Sinc, Exp.Rise, Exp.Fall, ECG, Gauss, Lorentz, Haversine	
Sine	Frequency Range	100 mHz to 25 MHz
	Flatness	± 0.5 dB (relative to 1 kHz)
	Harmonic Distortion	-40 dBc
	Spurious (non-harmonics)	-40 dBc
	Total Harmonic Distortion	1 %
	S/N Ratio	40 dB
Square/Pulse	Frequency Range	Square: 100 mHz to 15 MHz Pulse: 100 mHz to 1 MHz
	Rise/Fall Time	<15 ns
	Overshoot	<5%
	Duty	Square: always be 50% Pulse: 10% to 90%, adjustable
	Duty Cycle Resolution	1% or 10 ns (whichever is greater)
	Min. Pulse Width	20 ns
	Pulse Width Resolution	10 ns or 5 bits (whichever is greater)
	Jitter	5 ns
Ramp	Frequency Range	100 mHz to 100 kHz
	Linearity	1%
	Symmetry	1% to 100%
Noise	Bandwidth	>25 MHz
Built-in Waveform	Frequency Range	100 mHz to 1 MHz
Arbitrary Waveform	Frequency Range	100 mHz to 10 MHz
	Waveform Length	2~16 kpts
	Support loading channel waveforms (screen range and cursor range) and stored waveforms	
Frequency	Accuracy	100 ppm (<10 kHz), 50 ppm (>10 kHz)
	Resolution	100 mHz or 4 bits (whichever is greater)
Amplitude	Output Range	20 mVpp~5 Vpp (HighZ), 10 mVpp~2.5 Vpp (50 Ω)
	Resolution	100 uV or 3 bits (whichever is greater)
DC Offset	Accuracy	± (2% of setting+1 mV) (Frequency=1 kHz)
	Range	± 2.5 V (HighZ), ± 1.25 V (50 Ω)
	Resolution	100 uV or 3 bits (whichever is greater)
	Accuracy	± (2% of offset setting+5 mV+0.5% of amplitude)

Modulation	AM, FM, FSK	
	AM	Modulating Waveforms: Sine, Square, Triangle, and Noise.
		Modulation Frequency: 1 Hz to 50 kHz
		Modulation Depth: 0% to 120%
	FM	Modulating Waveforms: Sine, Square, Triangle, and Noise.
		Modulation Frequency: 1 Hz to 50 kHz
		Modulation Offset: 1 Hz to carrier frequency
	FSK	Modulating Waveforms: 50% duty cycle square
		Modulation Frequency: 1 Hz to 50 kHz
Sweep	Linear, Log, and Step	
	Sweep Time	1 ms to 500 s
	Start Frequency and End Frequency	Any frequencies within the waveform range
	N Cycle, Infinite	
Burst	Cycle Count	1 to 1000000
	Burst Period	1 μ s to 500 s
	Burst Delay	0 s to 500 s
	Trigger Source	Internal, Manual

Digital Voltmeter

Digital Voltmeter (technical specifications are typical values)

Source	Any analog channel
Function	DC, AC+DC RMS, and AC RMS
Resolution	ACV/DCV: 3 bits
Limits Beeper	Sound an alarm when the voltage value is within or outside of the limit range.
Range Measurement	Display the latest measurement results in the form of a diagram, and display the extrema over the last 3 seconds

High-precision Frequency Counter

High-precision Frequency Counter

Source	Any analog channel and digital channel	
Measure	Frequency, period, totalizer	
Counter	Resolution	Max. 6 bits, user-defined
	Max. Frequency	Max. bandwidth of the analog channel
Totalizer	48-bit totalizer	
	Edge	Count the number of the rising edges
Time Reference	Internal Reference	

Customization for Quick Key

Customization for Quick Key

Quick Screenshot	Quickly save the screen image to the specified path based on the current image storage menu settings.
Quick Waveform Save	Quickly save the screen or memory waveforms to the specified path based on the current waveform storage menu settings.
Quick Save Settings	Quickly save the setup file to the specified path based on the current setup storage menu settings.
Quick All Measurement	Display all the prompt message windows for all the measurement of the waveforms.
Quick Reset of Statistics	Quickly reset all the measurement statistics data and measurement counts.
	Quickly reset all the statistics information in PassFail function.
Quick Waveform Recording	Quickly start or stop the waveform recording.
Quick Email Sending	Quickly send the Email based on the set email address.
Quick Print	Quickly perform the print operation based on the current printer settings.
Quick Group Saving	Quickly perform the group saving function based on the currently selected item for saving.

Command Set

Command Set	
Common Commands Support	IEEE488.2 Standard
Error Message Definition	Error messages
Support Status Report Mechanism	Status reporting
Support Syn Mechanism	Synchronization

Display

Display	
LCD	9-inch capacitive multi-touch screen/gesture enabled operation
Resolution	1024 × 600 (Screen Region)
Graticule	(10 vertical divisions) × (8 horizontal divisions)
Persistence	Off, Infinite, variable persistence (100 ms to 10 s)
Brightness	256 intensity levels (LCD,HDMI)

I/O

I/O	
USB 2.0 Hi-speed Host Port	1 on the front panel
USB 2.0 Hi-speed Device Port	1 on the rear panel, compatible with USB Test and Measurement Class (USBTMC)
LAN	1 on the rear panel, 10/100/1000-port, supporting LXI-C
GPIOB	GPIOB-USB adapter (option)
Web Remote Control	Support VNC Web interface (input the IP address of the oscilloscope into the Web browser to display the operation interface of the oscilloscope)
Aux Out	BNC output on the rear panel. Vo (H) ≥ 2.5 V open circuit, ≥ 1.0 V 50 Ω to GND Vo (L) ≤ 0.7 V to load ≤ 4 mA; ≤ 0.25 V 50 Ω to GND
	Trigger Output Output a pulse signal when the oscilloscope is triggered.
	Pass/Fail Output a pulse signal when a pass/fail event occurs. Supports user-defined pulse polarity and pulse time (100 ns~10 ms).
HDMI video output	1 on the rear panel, HDMI 1.4b, A plug. used to connect to an external monitor or projector
Probe Compensation Output	1 kHz, 3 Vpp square waveform

Power

Power Supply	
Power Voltage	100 V~240 V, 45 Hz~440 Hz
Power	Max. 75 W (connect to various interfaces, USB)
Fuse	4 A, T degree, 250 V

Bode

Bode	
Start Frequency	10 Hz to 25 MHz
Stop Frequency	100 Hz to 25 MHz
Points/Decade	10 to 300
Output Amplitude	HighZ: 20 mV to 5 V; 50 Ω: 10 mV to 2.5 V

Environment

Environmental Stress		
Temperature Range	Operating	0°C~+50°C
	Non-operating	-30°C~+70°C
Humidity Range	Operating	Below +30°C: ≤90% RH (without condensation)
		+30°C to +40°C, ≤75% RH (without condensation)
	Non-operating	+40°C to +50°C, ≤45% RH (without condensation)
		Below 65°C: ≤90% RH (without condensation)
Altitude	Operating	Below 3,000
	Non-operating	Below 15,000

Warranty and Calibration Interval

Warranty and Calibration Interval	
Warranty	3 years
Recommended Calibration Interval	18 months

Regulations

Regulations	
Electromagnetic Compatibility	Compliant with EMC DIRECTIVE 2014/30/EU, compliant with or higher than the standards specified in IEC 61326-1:2013/EN 61326-1:2013 Group 1 Class A
	CISPR 11/EN 55011
	IEC 61000-4-2:2008/EN 61000-4-2 ± 4.0 kV (contact discharge), ± 8.0 kV (air discharge)
	IEC 61000-4-3:2002/EN 61000-4-3 3 V/m (80 MHz to 1 GHz); 3 V/m (1.4 GHz to 2 GHz); 1 V/m (2.0 GHz to 2.7 GHz)
	IEC 61000-4-4:2004/EN 61000-4-4 1 kV power line
	IEC 61000-4-5:2001/EN 61000-4-5 0.5 kV (phase-to-neutral voltage); 1 kV (phase-to-earth voltage); 1 kV (neutral-to-earth voltage)
	IEC 61000-4-6:2003/EN 61000-4-6 3 V, 0.15–80 MHz
Safety	IEC 61000-4-11:2004/EN 61000-4-11 voltage dip: 0% UT during half cycle; 0% UT during 1 cycle; 70% UT during 25 cycles short interruption: 0% UT during 250 cycles
	IEC 61010-1:2010 (Third Edition)/EN 61010-1:2010, UL 61010-1:2012 R4.16 and CAN/CSA-C22.2 NO. 61010-1-12+ G11+ G12
Vibration	Meet GB/T 6587; class 2 random Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random
Shock	Meet GB/T 6587-2012; class 2 random Meet MIL-PRF-28800F and IEC60068-2-27; class 3 random (in non-operating conditions: 30 g, half sine, 11 ms duration, 3 vibrations along the main axis, a total of 18 vibrations)

Mechanical Characteristics

Mechanical Characteristics	
Dimensions ^[4]	367 mm (W) × 200 mm (H) × 130 mm (D)
Weight ^[5]	Package Excluded <3.5 kg
	Package Included <5.8 kg
Rack Mount Kit	5U

Non-volatile Memory

Non-volatile Memory	
Data/File Storage	Setup/Image setup (*.stp), image (*.png, *.bmp, *.tif, *.jpg)
	Waveform Data CSV waveform data (*.csv), binary waveform data (*.bin, *.wfm), list data (*.csv), reference waveform data (*.ref, *.csv, *.bin), and arbitrary waveform data (*.arb)
Reference Waveform	Display 10 internal waveforms, and its storage is limited by the capacity
Setting	Storage is limited by the capacity
USB Capacity	Support the USB storage device that conforms to the industry standard

Note[1]: Half-channel mode: CH1 and CH2 are considered as a group; CH3 and CH4 are considered as another group. Each group share the same ADC sample, and either one of the channels in each group is enabled.

Note[2]: Maximum value, single-channel, 10 ns horizontal time base, input amplitude 4 div, sine wave signal with 10 MHz frequency. Others are default settings.

Note[3]: 1 mV/div and 2 mV/div are a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 1 mV/div and 2 mV/div sensitivity setting.

Note[4]: Supporting legs and handle folded, knob height included, front protective cover excluded.

Note[5]: Standard configuration.

Order Information

Order Information	Order No.
Model	
MSO5354 (350 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)	MSO5354
MSO5204 (200 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)	MSO5204
MSO5104 (100 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)	MSO5104
MSO5102 (100 MHz, 8 GSa/s, 100 Mpts, 2+16 CH MSO)	MSO5102
MSO5074 (70 MHz, 8 GSa/s, 100 Mpts, 4+16 CH MSO)	MSO5074
MSO5072 (70 MHz, 8 GSa/s, 100 Mpts, 2+16 CH MSO)	MSO5072
Standard Accessories	
Power cord conforming to the standard of the destination country	–
USB cable	CB-USBA-USBB-FF-150
2 or 4 passive probes (350 MHz)	PVP2350
Quick guide (hard copy)	–
Optional Accessories	
16 digital channels active logic probe (dedicated probe for MSO5000 series)	PLA2216
Front panel cover	MSO5000-FPC
Rack mount kit	MSO5000-RM
USB-GPIB interface converter	USB-GPIB
Near-field probe	NFP-3
Power analysis phase difference correction jig	RPA246
Digital oscilloscope demonstration plate	DK-DS6000
Bandwidth Upgrade Option	
Bandwidth upgrades from 70 MHz to 100 MHz	MSO5000-BW0T1
Bandwidth upgrades from 70 MHz to 200 MHz	MSO5000-BW0T2
Bandwidth upgrades from 70 MHz to 350 MHz	MSO5000-BW0T3
Bandwidth upgrades from 100 MHz to 200 MHz	MSO5000-BW1T2
Bandwidth upgrades from 100 MHz to 350 MHz	MSO5000-BW1T3
Bandwidth upgrades from 200 MHz to 350 MHz	MSO5000-BW2T3
Memory Depth Option	
Maximum memory depth up to 200 Mpts	MSO5000-2RL
Channel Number Upgrade Option	
Upgrade the number of analog channels to 4 (only available for the MSO5XX2 model)	MSO5000-4CH
Bundle Option	
Function and application bundle option, including MSO5000-COMP, MSO5000-EMBD, MSO5000-AUTO, MSO5000-FLEX, MSO5000-AUDIO, MSO5000-AERO, MSO5000-AWG, and MSO5000-PWR	MSO5000-BND
Serial Protocol Analysis Option	
PC serial bus trigger and analysis (RS232/UART)	MSO5000-COMP
Embedded serial bus trigger and analysis (I2C and SPI)	MSO5000-EMBD
Auto serial bus trigger and analysis (CAN and LIN)	MSO5000-AUTO
FlexRay serial bus trigger and analysis (FlexRay)	MSO5000-FLEX
Audio serial bus trigger and analysis (I2S, only available for the MSO5XX4 model or the model installed with the MSO5000-4CH option)	MSO5000-AUDIO
MIL-STD-1553 serial bus trigger and analysis (MIL-STD-1553)	MSO5000-AERO
Measurement Application Option	
Dual-channel 25 MHz arbitrary waveform generator	MSO5000-AWG
Built-in Power Analysis	MSO5000-PWR

Note: For all the mainframes, accessories and options, please contact the local office of **RIGOL**.

Warranty Period

Three years for the mainframe, excluding the probes and accessories

[illegible]

11/11/2016



Data Sheet

UDP3000S Series

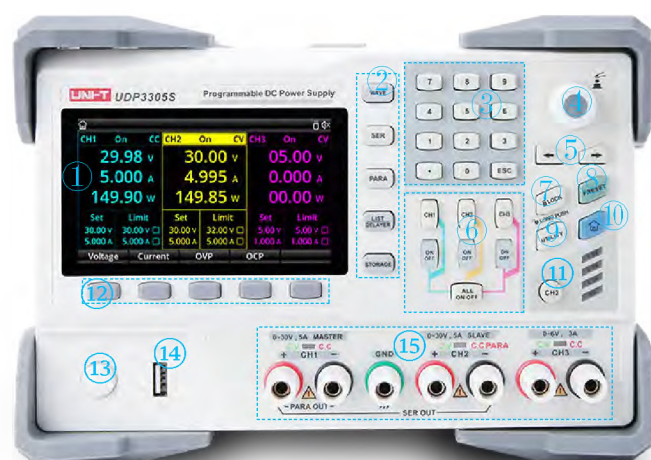
Programmable Linear DC Power Supply



Main Features

- Maximum power up to 373W
- Four channel independent output: CH1/CH2: 0~30V/5A, CH3: 0~6V/3A, CH4: 5V/2A
- Multiple protection: OCP/OVP/OTP
- Excellent load regulation and line regulation
- Ultra low output ripple and noise
- Support one key serial and parallel output function
- The 4.3-inch TFT display can display three channels and multiple parameters at the same time
- List / delayer function to control voltage and current output as required
- External trigger function to realize industrial automation control
- Provide USB host, USB device, LAN, RS232, digital IO and other interfaces
- With waveform display function, real-time and dynamic display of output voltage / current / power waveform
- Intelligent speed control of fan can effectively reduce fan noise during operation
- Support 10 groups of file storage and transfer out, and support USB flash disk reading and writing
- High precision display of five-digit voltage / four-digit current, with resolutions of 10mV / 1mA and 1mV / 1mA
- Keyboard lock function to prevent misoperation
- Support SCPI remote command control

DC Power Supply Panel



- ① LCD display ② Function key ③ Digital keyboard ④ Rotary encoder
- ⑤ Shift key ⑥ Channel selection and output control ⑦ Keyboard lock
- ⑧ Preset key ⑨ System settings ⑩ Home key ⑪ CH3 quick selection
- ⑫ Operation menu ⑬ Power switch ⑭ CH4 output
- ⑮ Output channel and indicator ⑯ USB HOST ⑰ LAN ⑱ USB device
- ⑲ Digital IO ⑳ RS232 ㉑ Fan ㉒ Input source selection ㉓ Protected GND
- ㉔ AC socket

Product Introduction

UDP3000S series is a high-performance programmable linear DC power supply. It has a clear LCD user interface, excellent performance indicators, a variety of analysis functions and communication interfaces. It can meet the diversified test needs of users. It aims to provide cost-effective DC programmable power supply equipment for teaching, scientific research, industry and other fields.

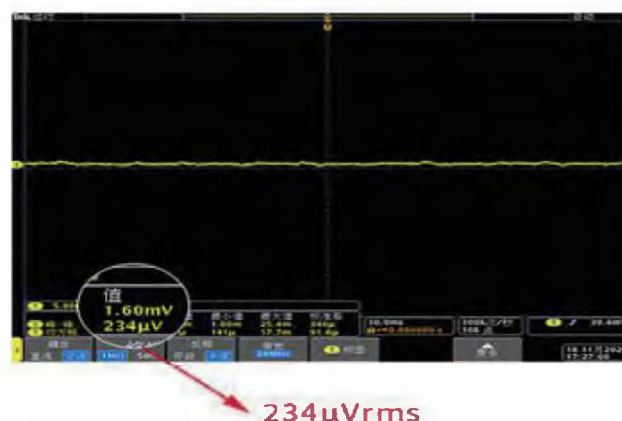
Human-computer interaction

UDP3000S series power supply has 4.3inch TFT LCD, which provides a human-computer interaction interface with rich functions and simple operation. The real-time information, setting value and limit value of three channels are displayed at the same time. The test interface is clear at a glance, saving the time of browsing and searching.



Excellent performance

UDP3000S series has excellent performance indicators. Provide cleaner and reliable DC power supply. It reduces unnecessary interference in use.



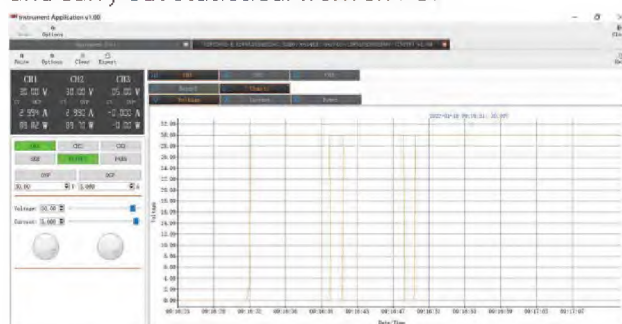
One key series parallel

All channels of this series of power supply are isolated from each other. One key series parallel connection of CH1 and CH2 can be realized through function keys. You do not need additional wiring. Just follow the interface diagram for wiring, which is fast and easy to operate. It provides you with a wider working range of power supply.



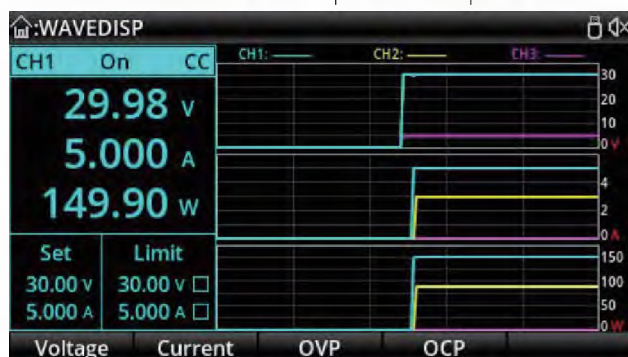
Remote control

This series of power supply provides a variety of remote connection interfaces of USB / LAN / RS232. It supports SCPI general protocol and is equipped with host computer software, which can set, view and carry out statistical work on PC.



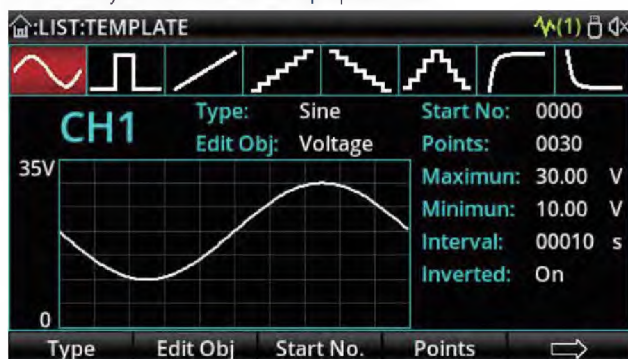
Waveform display

UDP3000S series power supply has waveform display function, which can intuitively display the change trend of voltage, current and power. Provide users with better operation experience.



List/delayer function

UDP3000S series provides list and delayer functions. The power output curve can be edited freely to meet the test requirements. The delayer can be applied to the on-off test to investigate the reliability of the tested equipment.



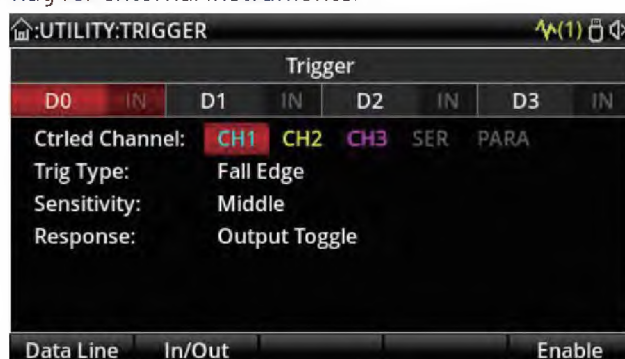
Protection function

UDP3000S series has OVP / OCP / OTP function to provide protection for power supply. It is equipped with current and voltage limit functions to provide guarantee for the tested equipment. It is equipped with monitor function, which can freely set protection conditions and give alarms.



External trigger

This series of power supply provides digital IO port, which can be edited as external trigger mode to realize remote control power supply. Set as output mode, it can provide trigger information and status flag for external instruments.



Preset function

UDP3000S series power supply can save 10 groups of list and delayer files respectively. You can save 5 sets of common configurations through presets. It provides convenience for quick access to common settings.

PRESET				
Preset1	Preset2	Preset3	Preset4	Preset5
	Volt(V)	Curr(A)	OVP(V)	OCP(A)
CH1	12.00	1.000	13.00 ☐	2.001 ☐
CH2	24.00	2.000	25.00 ☐	2.500 ☐
CH3	5.00	1.000	5.00 ☐	1.000 ☐
SER	36.00	5.000	36.00 ☐	5.000 ☐
PARA	30.00	06.000	30.00 ☐	06.000 ☐
Edit				Load

Technical Specification

Model		UDP3005S-E	UDP3005S
Channel	Channel	4	4
Output Rating	Voltage	CH1&CH2: 0~32V	CH1&CH2: 0~32V
		CH3: 0~6V	CH3: 0~6V
		CH4: 5V (USB Output)	CH4: 5V (USB Output)
	Current	CH1&CH2: 0~5A	CH1&CH2: 0~5A
		CH3: 0~3A	CH3: 0~3A
		CH4: 2A (USB Output)	CH4: 2A (USB Output)
CV mode	Power	348W	348W
	Regulation	Line Regulation: $\leq 0.01\%+2\text{mV}$	Line Regulation: $\leq 0.01\%+2\text{mV}$
		Load Regulation: $\leq 0.01\%+2\text{mV}$	Load Regulation: $\leq 0.01\%+2\text{mV}$
	Regulation	$<350\mu\text{Vrms}/2\text{mVpp}(5\text{Hz}-1\text{MHz})$	$<350\mu\text{Vrms}/2\text{mVpp}(5\text{Hz}-1\text{MHz})$
	Reaction time	$\leq 50\mu\text{s}$ (50% load variation, minimum load 0.5A)	$\leq 50\mu\text{s}$ (50% load variation, minimum load 0.5A)
CC mode	Command processing time	$<100\text{ms}$	$<100\text{ms}$
	Regulation	Line Regulation: $\leq 0.01\%+250\mu\text{A}$	Line Regulation: $\leq 0.01\%+250\mu\text{A}$
		Load Regulation: $\leq 0.01\%+250\mu\text{A}$	Load Regulation: $\leq 0.01\%+250\mu\text{A}$
Tracking mode	Ripple current	$\leq 2\text{mA}_{\text{rms}}$	$\leq 2\text{mA}_{\text{rms}}$
	parallel connection	Line Regulation: $\leq 0.01\%+2\text{mV}$	Line Regulation: $\leq 0.01\%+2\text{mV}$
		Load Regulation: $\leq 0.01\%+2\text{mV}$	Load Regulation: $\leq 0.01\%+2\text{mV}$
	series connection	Line Regulation: $\leq 0.01\%+3\text{mV}$	Line Regulation: $\leq 0.01\%+3\text{mV}$
		Load Regulation: $\leq 300\text{mV}$	Load Regulation: $\leq 300\text{mV}$
measure	Display	$\leq 0.5\%+10\text{mV}$ (10~30V No load)	$\leq 0.5\%+10\text{mV}$ (10~30V No load)
		$\leq 0.5\%+30\text{mV}$ (0~9.99V No load)	$\leq 0.5\%+30\text{mV}$ (0~9.99V No load)
	Tracking error	Access load $\leq 300\text{mV}$	Access load $\leq 300\text{mV}$
	Programming resolution	Voltage full scale, 4-digit display: 4.3inch LCD	Voltage full scale, 5-digit display: 4.3inch LCD
		Current full scale, 4-digit display: 4.3inch LCD	Current full scale, 4-digit display: 4.3inch LCD
	Readback resolution	Voltage: 10mV	Voltage: 1mV
		Current: 1mA	Current: 1mA
	Programming accuracy (25 $\pm$ 5 C)	Voltage: $\pm (0.3\%+20\text{mV})$	Voltage: $\pm (0.03\%+10\text{mV})$
		Current: $\pm (0.2\%+5\text{mA})$	Current: $\pm (0.2\%+5\text{mA})$
Voltage programmed speed (1% of the total variation range)	Readback accuracy (25 $\pm$ 5 C)	Voltage: $\pm (0.1\%+20\text{mV})$	Voltage: $\pm (0.03\%+10\text{mV})$
		Current: $\pm (0.15\%+5\text{mA})$	Current: $\pm (0.15\%+5\text{mA})$
	CH1	Rise: full load $< 50\text{ms}$; No load $< 30\text{ms}$	Rise: full load $< 50\text{ms}$; No load $< 30\text{ms}$
		Fall: full load $< 45\text{ms}$; No load $< 400\text{ms}$	Fall: full load $< 45\text{ms}$; No load $< 400\text{ms}$
	CH2	Rise: full load $< 50\text{ms}$; No load $< 30\text{ms}$	Rise: full load $< 50\text{ms}$; No load $< 30\text{ms}$
		Fall: full load $< 45\text{ms}$; No load $< 400\text{ms}$	Fall: full load $< 45\text{ms}$; No load $< 400\text{ms}$
Temperature coefficient per C (output percentage + offset)	CH3	Rise: full load $< 15\text{ms}$; No load $< 13\text{ms}$	Rise: full load $< 15\text{ms}$; No load $< 13\text{ms}$
		Fall: full load $< 22\text{ms}$; No load $< 100\text{ms}$	Fall: full load $< 22\text{ms}$; No load $< 100\text{ms}$
	CH1	Voltage: $0.01\%+5\text{mV}$	Voltage: $0.01\%+5\text{mV}$
		Current: $0.01\%+2\text{mA}$	Current: $0.01\%+2\text{mA}$
	CH2	Voltage: $0.01\%+5\text{mV}$	Voltage: $0.01\%+5\text{mV}$
		Current: $0.01\%+2\text{mA}$	Current: $0.01\%+2\text{mA}$
	CH3	Voltage: $0.01\%+2\text{mV}$	Voltage: $0.01\%+2\text{mV}$
		Current: $0.01\%+2\text{mA}$	Current: $0.01\%+2\text{mA}$

Channel 4 (USB output)	Output voltage	5V ±0.25V	5V ±0.25V
	Output current	2A	2A
Input	Voltage	AC 100V/120V/220V/230V±10%	AC 100V/120V/220V/230V±10%
	Frequency	50/60Hz	50/60Hz
	Power	MAX 600W	MAX 600W
	Fuse	AC220V : T4AL250V	AC220V : T4AL250V
		AC110V : T8AL250V	AC110V : T8AL250V
Environment	Operating temperature	0°C~40°C	0°C~40°C
	Operating humidity	20%~80% (non-condensing)	20%~80% (non-condensing)
	Storage temperature	-10°C~60°C	-10°C~60°C
	Altitude	≤2000 m	≤2000 m
	Pollution degree	2	2
Size and weight	Size	355mm*240mm*168mm	355mm*240mm*168mm
	Weight	10.2kg	10.2kg



*The UDP3000S series have been certified by CE, UKCA, cTUVus

Accessories	
Standard accessories	Power cord that meets the standards of the country of destination
	USB data cable
Optional accessories	Alligator clip test line

Warranty

Three-years warranty, excluding probes and accessories.

Please visit https://instruments.uni-trend.com/list_190/65.html to learn more information.

To protect your investment, please purchase from UNI-T official authorized global distributors.

Find a Distributor

Find an authorized distributor here: [REDACTED]

Contact UNI-T

E-mail: info@uni-trend.com

Test & Measurement Instruments Website: instruments.uni-trend.com

UNI-T group maintains a wide products category includes Digital Test & Measurement instruments, Field Testing Meter, Infrared thermal imaging products. As early as 2008, we continue to introduce self-developed Digital Test and Measurement instruments to the market and have made remarkable achievements. At present, we have formed a variety of product lines of Oscilloscope, AWG, Spectrum Analyzer, Bench Multi-meter, Power Supply, DC Load, Power Meter, LCR Meter, Micro Ohm Meter and Data logger. We have separated instruments sub-sites, instruments.uni-trend.com, on the basis of the original website www.uni-trend.com, in order to be more targeted to provide customers with better service and value.

UNITMKT-TMI-SCAL-2205-029

Instrument.uni-trend.com

UNI-T®

Voltage / Temperature (Thermocouple)



MCR-4V Specifications		
Measurement Channels	Voltage 4ch	
Sensing Method	Differential Input, Each Channel Isolated	
Input Impedance	>10 M Ω per ch	
Input Frequency	DC-100 kHz	
Measurement Range	±200 mV, ±5 V, ±5 kV AC/ V _{pk} (1)	
Accuracy	±200 mV: ±0.3 % + 0.5 mV (1) ±5 V: ±0.3 % + 0.05 mV ±5 kV: ±0.3 % + 0.05 mV Auto: Auto-ranging to full range in use	
Measurement Resolution	50: 60-Hz Filter ON: 0.01 mV 50: 60-Hz Filter OFF: 0.1 mV	
Purview Function	Alleviate Voltage Range: 3 to 24 V (external power supply)	
Recording Method	Measurement, Waveform, Screen Capture, 128 K	
Recording Interval	2.5, 10, 30, 60, 120, 300, 600 sec. (1, 2, 5, 10, 15, 20, 30, 60 sec.)	
Logging Capacity (2)	The minimum interval will depend on the number of channels. When recording 1 channel: up to 960,000 readings/ch When recording 2 channels: up to 480,000 readings/ch When recording 3 channels: up to 320,000 readings/ch When recording 4 channels: up to 240,000 readings/ch One time Stop recording interval Start (by individual trigger or by group) One time Stop recording interval Stop (by individual trigger or by group)	
Recording Mode	Endless (Overwrite the most recent data when capacity is full) or One time Stop recording interval Start (by individual trigger or by group)	
Recording Start Method	Recording Start Method	
Recording Start Trigger	Immediate Start or Programmed Start (by individual trigger or by group)	
Communication Interfaces	Up to 4 V_{IN} (14 channels) can be recorded simultaneously. Coupling of MCR-4V and MCR-4T is possible. (3)	
LCD Display Items	Measurements, Trend Graph, Battery Level, etc.	
Communication Time	Download Time for Full Data via USB: 1 min. (100 sec.) From a data unit: Approx. 4 minutes 30 seconds	
External Memory	32 Memory Card, SDHC Memory Card (4) For Manual or Automatic Data Export	
Power	AA Alkaline Battery x 2 (AA Ni-MH batteries may also be used). USB Power (5V 250 mA)	
Battery Life (5)	Approx. 4 to 8 days (1 with AA Alkaline batteries)	
Preload Terminal	Compatible Wires	
Isolation	Single Wire: ±0.32 to 0.65 pF (AWG 28 - 22) Shielded Cable: 0.08 to 0.32 nF (AWG 28 - 22), ±0.12 nF or more in diameter CH1, CH2, CH3, CH4, UDS, and Pinflex are isolated. (Battery terminals are isolated from the CH1-CH4 input terminals.) Electrical Isolation Resistance: 50 MΩ or more (DC < 250 V)	
Dimensions	Approx. 120 mm x 75 mm x 32 mm	
Operating Environment	Temperature: 0 to 50 °C Humidity: 20 %RH or less (no condensation)	
Accessories	Software (CD-ROM), Card Slot Cover, User's Manual Set (Manually Included)	

(1) When "Auto" is selected, measurement shift will be automatically changed according to the voltage being measured.

(2) If the logging capacity is not filled at the end of one recording session, this logger can record up to 30 times more.

(3) Even Recording may not be started depending on the recording or measurement manual specifications of the connected Master unit.

(4) Please check the T&O Website for information on memory cards whose operation has been confirmed.

(5) Battery life varies depending on the recording or measurement manual specifications of the connected Master unit.

(6) All external inputs on operations 2010 and 2015 are 100 M Ω and 100 pF. The battery and are in the way a guarantee of actual battery life.

MCR-4T Specifications		
Measurement Channels	Temperature 4ch	
Communication	Communication Type K, L, T, S, B	
Measurement Range	Type K: -270 to 1370 °C Type L: -210 to 120 °C Type T: -270 to 400 °C Type S: -50 to 170 °C Type B: -50 to 170 °C	
Accuracy	Approx. 1 MΩ Thermocouple Measurement Type K, L, T: ±0.5 °C + 0.3 % reading (1) at -107 °C or above (1) Type S: ±0.5 °C + 0.3 % reading (1) at 107 °C or above (1) Individual sensor accuracies not included. Cold Junction Compensation ±0.3 °C in operating temperature ±0.3 °C (1 channel, operating environment)	
Measurement Resolution	Instantaneous or Average	
Recording Method	100, 300, 500 ms. (1, 2, 5, 10, 15, 20, 30, 60 sec.) 1, 2, 5, 10, 15, 20, 30, 60 min.	
Logging Capacity (2)	When recording 1 channel: up to 960,000 readings/ch When recording 2 channels: up to 480,000 readings/ch When recording 3 channels: up to 320,000 readings/ch When recording 4 channels: up to 240,000 readings/ch Endless (Overwrite the most recent data when capacity is full) or One time Stop recording interval Start (by individual trigger or by group) One time Stop recording interval Stop (by individual trigger or by group) Coupling of MCR-4T and MCR-4V is possible. (3)	
Recording Start Method	Recording Start Method	
Recording Start Trigger	Immediate Start or Programmed Start (by individual trigger or by group)	
Communication Interfaces	Up to 4 V_{IN} (14 channels) can be recorded simultaneously. Coupling of MCR-4V and MCR-4T is possible. (3)	
LCD Display Items	Measurements, Trend Graph, Battery Level, etc.	
Communication Time	Download Time for Full Data via USB: 1 min. (100 sec.) From a data unit: Approx. 4 minutes 30 seconds	
External Memory	32 Memory Card, SDHC Memory Card (4) For Manual or Automatic Data Export	
Power	AA Alkaline Battery x 2 (AA Ni-MH batteries may also be used). USB Power (5V 250 mA)	
Battery Life (5)	Approx. 4 to 8 days (1 with AA Alkaline batteries)	
Preload Terminal	Compatible Wires	
Isolation	Single Wire: ±0.32 to 0.65 pF (AWG 28 - 22) Shielded Cable: 0.08 to 0.32 nF (AWG 28 - 22), ±0.12 nF or more in diameter CH1, CH2, CH3, CH4, UDS, and Pinflex are isolated. (Battery terminals are isolated from the CH1-CH4 input terminals.) Electrical Isolation Resistance: 50 MΩ or more (DC < 250 V)	
Dimensions	Approx. 120 mm x 75 mm x 32 mm	
Operating Environment	Temperature: 0 to 50 °C Humidity: 20 %RH or less (no condensation)	
Accessories	Software (CD-ROM), Card Slot Cover, User's Manual Set (Manually Included)	

(1) When "Auto" is selected, measurement shift will be automatically changed according to the voltage being measured.

(2) If the logging capacity is not filled at the end of one recording session, this logger can record up to 30 times more.

(3) Even Recording may not be started depending on the recording or measurement manual specifications of the connected Master unit.

(4) Please check the T&O Website for information on memory cards whose operation has been confirmed.

(5) Battery life varies depending on the recording or measurement manual specifications of the connected Master unit.

(6) All external inputs on operations 2010 and 2015 are 100 M Ω and 100 pF. The battery and are in the way a guarantee of actual battery life.

Software (MCR for Windows)		
Compatible Devices	MCR-4V, MCR-4T	
Compatible OS (1)	Microsoft Windows 8/32/64 bit (2)	
Display Language (3)	English	

(1) The .NET Framework 4 Client Profile is required. (4)

(2) If for installation, it is necessary to have Administrator (Computer Administrator) rights.

(3) If you are using Windows 8, please note that our software is designed to be used in "Desktop" mode.

(4) We recommend using an operating system in the same language as the display language. Operation in different languages is not guaranteed.

(5) During the installation process of the software, if not present, .NET Framework 4 Client Profile will be installed automatically.

Caution regarding safety
For safe operation carefully read instructions before using the product.


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E-mail : sales@tandd.com
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Abstract

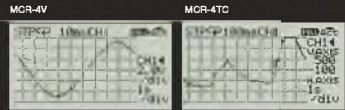


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4-Channel Battery Operated Data Loggers Up to 16 Channels of Simultaneous Recording

Easy Connection of MCR-4V and MCR-4TC
for Synchronous Measurement of Voltage and Temperature

Trend Graph for Real-Time Data Check



Easy Touch Panel Operation

Large Capacity Internal Memory

MCR-4V: Data logging up to 480,000 readings
MCR-4TC: Data logging up to 960,000 readings

Electrical Isolation between Channels

MCR-4V: Capable of measuring signals of different potentials
MCR-4TC: Possible to directly connect the exposed thermocouple junction to the measured object

Runs on 2 AA Alkaline Batteries or USB Bus Power

SD Memory Cards for Long-Period Recording

- The latest information on memory cards whose operation has been confirmed is available on the product page of our T&D website.
- When coupling units, please prepare a memory card for each unit.

MCR-4V Features

Preheat Function for Saving Battery Power

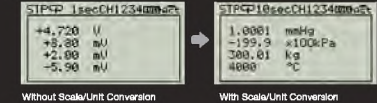


Quick and Precise Measurements Recording Interval as short as 2 msec / Resolution of 10 μ V

Number of Channels	Shortest Possible Recording Interval
1 ch	2 msec
2 ch	5 msec
4 ch	10 msec

- Number of channels determines shortest possible recording interval.
- Two recording methods: Instantaneous value or average value.

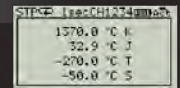
Scale and Unit Conversion for Recording and Viewing



MCR-4TC Features

Support for Variety of Thermocouple Types (K, J, T, S, R)

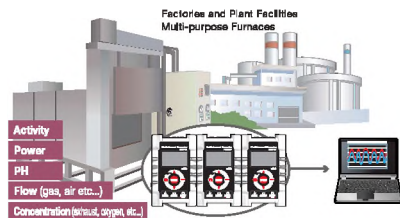
Wide Measurement Range from -270 to 1760°C (varies with sensor type)



Application Examples

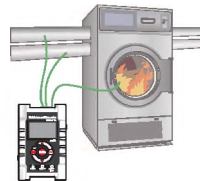
MCR-4V

- Measure and record data for control devices and measurement instruments in factories
- Record signals from actinometers, anemoscopes and CO₂ meters
- Record output signals from a variety of sensors and analyzers
- Measure voltage in electrical circuits



MCR-4TC

- Record temperatures in pipes and ducts
- Record boiler temperatures
- Record temperatures in cooking equipment such as pans, fryers, and ovens
- For temperature management of refrigerated and frozen goods

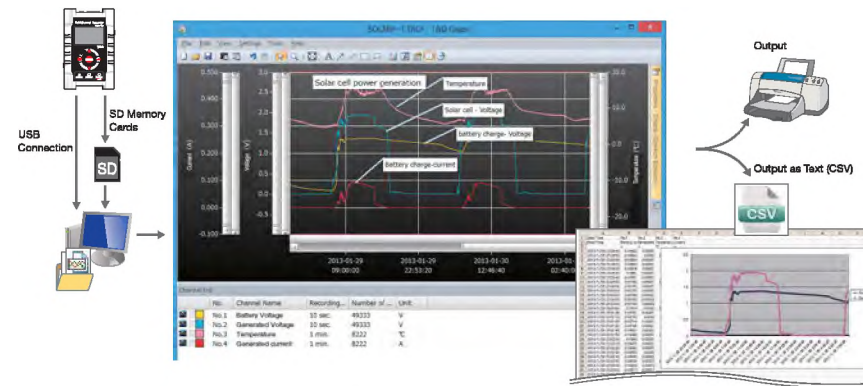


MCR-4V and MCR-4TC

- For temperature and pressure measurements inside slow cookers, pressure cookers, or other enclosed cooking containers.
- Measure air-conditioner gas pressure and outlet air temperature
- For measurement of engine combustion pressure and water cooling temperature.

T&D Graph: High Performance Graph Tool

- View recorded data in colorful graph form as well as analyze data using generated cumulative values, highest, lowest, and average readings.
- Add comments and memos directly to graphs.
- Save data in GSV text format for use with spreadsheet software.



RIGOL

Data Sheet

DM3058/DM3058E Digital Multimeter

Product Overview

DM3058/DM3058E^[1] is a digital multimeter designed with 5½ digits readings resolution and dual-display especially fitting to the needs of high-precision, multifunction and automatic measurement.



Applications

- Research&Development Laboratory
- Scientific Research and Education
- Detection and Maintenance
- Quality Test
- Automatic Production Test

Main Features

- Real 5½ digits readings resolution (240,000 Counts)
- Up to 123 rdgs/s measurement speed
- True-RMS AC Voltage and AC Current measuring
- Quickly Save or Recall the 10 groups of Preset Configuration
- Preset 10 groups of Standard Sensor Configuration, built-in cold terminal compensation for thermocouple
- Clone the instrument configurations into other DM3058/DM3058E via USB storage device
- The first 5½ digit digital multimeter passing LXI Criterion in industry, which can achieve system integration easily
- With easy, convenient and flexible any sensor measurement control software: UltraSensor
- Standard configuration interface: USB Device, USB Host, LAN (only for DM3058), RS-232, GPIB (only for DM3058)
- Support remote control via commands and compatible with commands of main stream multimeters

Easy to Use Design

- 256×64 LCD
- Support double display, Chinese and English menu
- Built-in help system makes information acquisition more easier
- File management (support for USB-disk and local storage)

Powerful Measurement Functions

➤ Basic Measurement Function

- DC Voltage: 200 mV ~ 1000 V
- DC Current: 200 μA ~ 10 A
- AC Voltage: True-RMS, 200 mV ~ 750 V
- AC Current: True-RMS, 20 mA ~ 10 A
- 2-Wire, 4-Wire Resistance: 200 Ω ~ 100 MΩ
- Capacitance Measurement: 2 nF ~ 10000 μF
- Continuity Test: Range is fixed at 2 kΩ
- Diode Test: Range is fixed at 2.0 V
- Frequency Measurement: 20 Hz ~ 1 MHz
- Period Measurement: 1 μs ~ 0.05 s
- Any Sensor Measurement: Support for 6 types of sensor (DCV, DCI, Freq, 2WR, 4WR and TC)

➤ Math Function

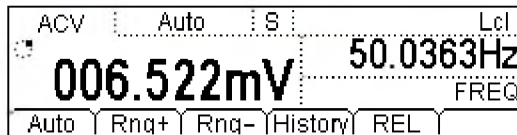
Max, Min, Average, Standard Deviation, Pass/Fail, dBm, dB, Relative Measurement and Histogram

Note^[1]: The difference between DM3058 and DM3058E is only that DM3058E doesn't support LAN and GPIB interfaces.

Jun. 2024

RIGOL TECHNOLOGIES CO., LTD.

Double Display



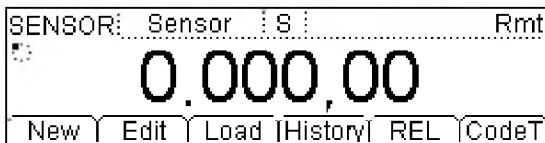
Dual-display function makes your measurements achieve maximum results with little effort. It can display two performances of a signal simultaneously instead of two multimeters or measurements in the past.

Preset Mode



Based on Preset Mode, the worker operation on product line could be greatly simplified. Besides, 10 groups of Preset Configuration are available to be stored and recalled.

Any Sensor Measurement

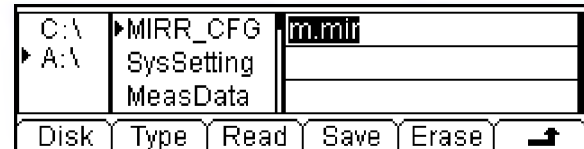


Any sensor measurement is a new conception being forward to meet user's requirements. By this particular function, you can easily connect pressure sensor or flux sensor or temperature sensor.

The multimeter supports 6 kinds of sensor (DCV, DCI, Freq, 2WR, 4WR and TC). Meanwhile, there are 10 groups of standard sensor configuration preset within the instrument.

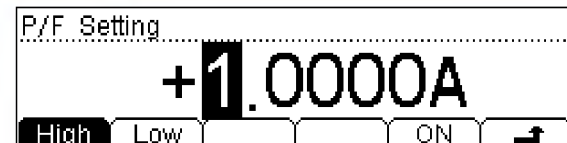
Thermocouple Cold Terminal compensation is built in the multimeter.

Mirror Image Configuration



All the configurations (system and sensor configuration) can be cloned into other DM3058/DM3058E on product line via USB storage device to improve work efficiency.

Pass/Fail



Pass/Fail test function can prompt for signals beyond the range based on specified higher and lower limit, and make test result more obvious.

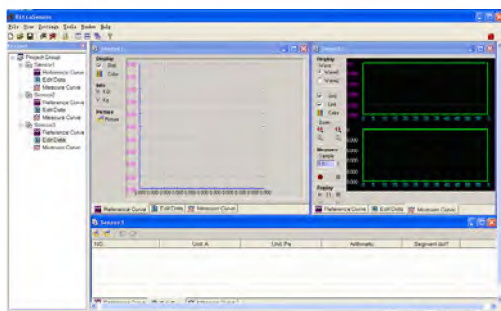
LXI & Web Control

DM3058 is the first 5½ digit digital multimeter passing LXI Criterion in industry that makes system integration easier.

Remote Control for DM3058 can be achieved by virtual panel from Web page in the same operation way with front panel of instrument.



Easy, Convenient and Flexible Control Software



UltraSensor Software Interface

UltraSensor is used to control any sensor. The main functions include:

- Create a project for any sensor measurement which can be download to the multimeter;
- Connect with the multimeter to achieve any sensor measurement;
- Monitor the sensor data in real time and show them in the form of figure;
- Enable to save data in the format of CSV and TXT and reference curve in the format of BMP.

Specifications

DC Characteristics

Function	Range ^[2]	Test current or Load voltage	Accuracy ± (% of reading + % of range) ^[1]	
			1 Year 23°C ± 5°C	Temperature Coefficient 0°C - 18°C 28°C - 50°C
DC Voltage	200.000 mV		0.015 + 0.004	0.0015 + 0.0005
	2.00000 V		0.015 + 0.003	0.0010 + 0.0005
	20.0000 V		0.015 + 0.004	0.0020 + 0.0005
	200.000 V		0.015 + 0.003	0.0015 + 0.0005
	1000.00 V ^[4]		0.015 + 0.003	0.0015 + 0.0005
DC Current	200.000 µA	<8 mV	0.055 + 0.005	0.003 + 0.001
	2.00000 mA	<80 mV	0.055 + 0.005	0.002 + 0.001
	20.0000 mA	<0.05 V	0.095 + 0.020	0.008 + 0.001
	200.000 mA	<0.5 V	0.070 + 0.008	0.005 + 0.001
	2.00000 A	<0.1 V	0.170 + 0.020	0.013 + 0.001
	10.0000 A ^[5]	<0.3 V	0.250 + 0.010	0.008 + 0.001
Resistance ^[3]	200.000 Ω	1 mA	0.030 + 0.005	0.0030 + 0.0006
	2.00000 kΩ	1 mA	0.020 + 0.003	0.0030 + 0.0005
	20.0000 kΩ	100 µA	0.020 + 0.003	0.0030 + 0.0005
	200.000 kΩ	10 µA	0.020 + 0.003	0.0030 + 0.0005
	2.00000 MΩ	1 µA	0.040 + 0.004	0.0040 + 0.0005
	10.0000 MΩ	200 nA	0.250 + 0.003	0.0100 + 0.0005
	100.000 MΩ	200 nA 10 MΩ	1.75 + 0.004	0.2000 + 0.0005
Diode Test	2.0000 V ^[6]	1 mA	0.05 + 0.01	0.0050 + 0.0005
Continuity Test	2000 Ω	1 mA	0.05 + 0.01	0.0050 + 0.0005

Remarks:

- [1] Specifications are for 0.5 hour warm-up, "Slow" measurement rate and calibration temperature 18°C ~ 28°C.
- [2] 20% over range on all ranges except for DCV 1000 V, ACV 750 V, DCI 10 A and ACI 10 A.
- [3] Specifications are for 4-wire measure or 2-wire measure under "REF" operation. ± 0.2 Ω of extra errors will be generated if perform 2-wire measure without "REF" operation.
- [4] Plus 0.02 mV of error per 1 V after the first ±500 VDC.
- [5] 30 seconds OFF after 30 seconds ON is recommend for the continuous current that higher than DC 7 A or AC RMS 7 A.
- [6] Accuracy specifications are only for voltage measuring at input terminal. The typical value of current under measure is 1 mA. Voltage drop at the diode junction may vary with current supply.

DC Voltage	
Input Resistance	200 mV and 2 V 10 MΩ or >10 GΩ selectable (Input signals that exceed ± 2.5 V in these ranges will pass the 100 kΩ (typical) clamp resistance.) 20 V, 200 V and 1000 V 10 MΩ ± 2%
Input Bias Current	<90 pA, 25°C
Input Protection	1000 V on all ranges
CMRR (common mode rejection ratio)	120 dB (For the 1 kΩ unbalanced resistance in LO lead, maximum ± 500 VDC)
NMRR (normal mode rejection ratio)	60 dB at "slow" measurement rate 20 dB are added if open the "AC filter" (Settling time will add 0.35 s while source impedance nears zero)
Resistance	
Testing Method	4-wire resistance or 2-wire resistance optional For current source refer to LO input
Open-circuit Voltage	P/F in <8 V
Maximum Lead Resistance (4-wire resistance)	10% of ranges, on the range of 200 Ω, 1 kΩ, for each lead 1 kΩ, on all other ranges, for each lead
Input Protection	1000 V, on all ranges

DC Current	
Shunt Resistor	200 μ A sampling voltage < 8 mV 2 mA sampling voltage < 80 mV 1 Ω for 20 mA, 200 mA 0.008 Ω for 2 A, 10 A
Input Protection	Rear panel: accessible 10 A, 250 V fast-melt fuse Internal: 12 A, 250 V slow-melt fuse
Continuity / Diode Test	
Measurement Method	1 mA $\pm$ 5% constant-current source, < 8 V open-circuit voltage
Response Time	123 samples/sec, with beeper
Continuity Threshold	Adjustable between 1 Ω and 2000 Ω
Input Protection	1000 V
Setup time Attentions	
The setup time about voltage measurement is influenced by source resistance and media characteristics of cable as well as input signal.	

AC Characteristics

Accuracy ± (% of reading + % of range) ^[1]				
Function	Range ^[2]	Frequency Range	1 Year 23°C ±5°C	Temperature Coefficient 0°C - 18°C 28°C - 50°C
True RMS AC Voltage ^[3]	200.000 mV	20 Hz – 45 Hz	1.5 + 0.10	0.01 + 0.005
		45 Hz – 20 kHz	0.2 + 0.05	0.01 + 0.005
		20 kHz – 50 kHz	1.0 + 0.05	0.01 + 0.005
		50 kHz – 100 kHz	3.0 + 0.05	0.05 + 0.010
	2.00000 V	20 Hz – 45 Hz	1.5 + 0.10	0.01 + 0.005
		45 Hz – 20 kHz	0.2 + 0.05	0.01 + 0.005
		20 kHz – 50 kHz	1.0 + 0.05	0.01 + 0.005
		50 kHz – 100 kHz	3.0 + 0.05	0.05 + 0.010
	20.0000 V	20 Hz – 45 Hz	1.5 + 0.10	0.01 + 0.005
		45 Hz – 20 kHz	0.2 + 0.05	0.01 + 0.005
		20 kHz – 50 kHz	1.0 + 0.05	0.01 + 0.005
		50 kHz – 100 kHz	3.0 + 0.05	0.05 + 0.010
	200.000 V	20 Hz – 45 Hz	1.5 + 0.10	0.01 + 0.005
		45 Hz – 20 kHz	0.2 + 0.05	0.01 + 0.005
		20 kHz – 50 kHz	1.0 + 0.05	0.01 + 0.005
		50 kHz – 100 kHz	3.0 + 0.05	0.05 + 0.010
	750.000 V	20 Hz – 45 Hz	1.5 + 0.10	0.01 + 0.005
		45 Hz – 20 kHz	0.2 + 0.05	0.01 + 0.005
		20 kHz – 50 kHz	1.0 + 0.05	0.01 + 0.005
		50 kHz – 100 kHz	3.0 + 0.05	0.05 + 0.010
True RMS AC Current ^[5]	20.0000 mA	20Hz – 45 Hz	1.5 + 0.10	0.015 + 0.015
		45 Hz - 2 kHz	0.50 + 0.10	0.015 + 0.006
		2 kHz -10 kHz	2.50 + 0.20	0.015 + 0.006
	200.000 mA	20 Hz - 45 Hz	1.50 + 0.10	0.015 + 0.005
		45 Hz – 2 kHz	0.30 + 0.10	0.015 + 0.005
		2 kHz - 10 kHz	2.50 + 0.20	0.015 + 0.005
	2.00000 A	20 Hz – 45 Hz	1.50 + 0.20	0.015 + 0.005
		45 Hz - 2 kHz	0.50 + 0.20	0.015 + 0.005
		2 kHz – 10 kHz	2.50 + 0.20	0.015 + 0.005
	10.0000 A ^[5]	20 Hz – 45 Hz	1.50 + 0.15	0.015 + 0.005
		45 Hz - 2 kHz	0.50 + 0.15	0.015 + 0.005
		2 kHz – 5 kHz	2.50 + 0.20	0.015 + 0.005
Additional wave crest factor error (not Sine) ^[6]				
Wave crest coefficient		Error (% range)		
1 - 2		0.05		
2 - 3		0.2		

Remarks:

[1] Specifications are for 0.5 hour warm-up, "Slow" measure and calibration temperature 18°C - 28°C.

[2] 20% over range on all ranges except for DCV 1000 V, ACV 750 V, DCI 10 A and ACI 10 A.

- [3] Specifications are for amplitude of sine wave input >5% of range. 750 V range limited to 8×10^7 Volt-Hz. For inputs from 1% to 5% of range and <50 kHz, add 0.1% of range extra error. For 50 kHz to 100 kHz, add 0.13%.
- [4] Specifications are for sine wave input >5% of range. 0.1% errors will be added when the range of input sine wave is 1% ~ 5%.
- [5] 30 seconds OFF after 30 seconds ON is recommend for the continuous current that higher than DC 7 A or AC RMS 7 A.
- [6] For frequency <100 Hz.

True RMS AC Voltage	
Measurement Method	AC coupled true RMS measure - up to 1000 V DC bias are permitted on every range
Wave Crest Factor	≤ 3 at full scale
Input Impedance	$1 \text{ M}\Omega \pm 2\%$ in parallel with <100 pF on all ranges
AC Filter Bandwidth	20 Hz ~ 100 kHz
CMRR (common mode rejection ratio)	60 dB (For the $1 \text{ k}\Omega$ imbalance resistance among Lo lead and <60 Hz, maximum ± 500 VDC)
True RMS AC Current	
Measurement Method	DC coupled to the fuse and shunt; AC coupled the True RMS measurement (measures the AC components only)
Wave Crest Factor	≤ 3 at full scale
Maximum Input	The DC + AC current peak value <300% of range. The RMS current including DC current is <10 A
Shunt Resistor	$1 \text{ }\Omega$ for 20 mA, 200 mA $0.008 \text{ }\Omega$ for 2 A, 10 A
Input Protection	Rear panel: accessible 10 A, 250 V fast-melt fuse Internal: 12 A, 250 V slow-melt fuse

Setup Time Attentions

Make sure that the RC return at input terminal has been in a stable state completely (higher than 1 s) before accurate measurement;

Input >300 Vrms (or >5 Arms) will cause the self heating of the signal conditioning component to generate error; this error is included in the characteristics of the instrument. Internal temperature variation results from the self heating will cause additional an error on ac range that is lower than 0.03% of readings, and it will disappear after a few minutes.

Frequency and Period Characteristics

Function	Range	Frequency Range	Accuracy $\pm$ (% of reading + % of range) ^[1]	
			1 Year 23°C $\pm$ 5°C	Temperature Coefficient 0°C - 18°C 28°C - 50°C
Frequency/Perbd	200 mV - 750 V ^[2]	20 Hz - 2 kHz	0.01 + 0.003	0.002 + 0.001
		2 kHz - 20 kHz	0.01 + 0.003	0.002 + 0.001
		20 kHz - 200 kHz	0.01 + 0.003	0.002 + 0.001
		200 kHz - 1 MHz	0.01 + 0.006	0.002 + 0.002
	20 mA - 10 A ^[3]	20 Hz - 2 kHz	0.01 + 0.003	0.002 + 0.001
		2 kHz - 10 kHz	0.01 + 0.003	0.002 + 0.001

Remarks:

- [1] Specifications are for 0.5 hour warm-up.
- [2] Except for special marks, the AC input voltage is 15% to 120% of range when <100 kHz and 40% to 120% of range when >100 kHz. 750 V range is limited to 750 VRMS. 200 mV ranges is for full scale or higher. For inputs from 30 mV to 200 mV, multiply total % of reading error by 10.
- [3] For AC input current from 15% to 120% of range except where noted. 20 mA range specifications are for full scale. For inputs from 5 mA to 20 mA, multiply total % of reading error by 10. 10 A range is for AC input current from 25% to 100% of range.

Frequency and Period

Measurement Method: Reciprocal-counting technique, AC-coupled input, AC voltage or AC current measurement function

Measure Attentions

Generally, errors are leaded into all frequency counters when measuring low voltage or low frequency signal. Shielding input can extremely help to reduce measuring errors caused by exterior noise.

Setup Time Attentions

If the variational DC components appeared in signals under measure, errors may be caused while measuring period or frequency. Please ensure that the RC loop at input terminal must be stable during exact measuring (higher than 1 sec).

Capacitance Characteristics

Function	Range ^[2]	Maximum Testing Current	Accuracy ± (% of reading + % of range) ^[1]	
			1 Year 23°C ±5°C	Temperature Coefficient 0°C - 18°C 28°C - 50°C
Capacitance	2.000 nF	200 nA	3 + 1.0	0.08 + 0.002
	20.00 nF	200 nA	1 + 0.5	0.02 + 0.001
	200.0 nF	2 µA	1 + 0.5	0.02 + 0.001
	2.000 µF	10 µA	1 + 0.5	0.02 + 0.001
	200 µF	100 µA	1 + 0.5	0.02 + 0.001
	10000 µF	1 mA	2 + 0.5	0.02 + 0.001

Remarks:

[1] Specifications are for 0.5 hour warm-up and "REF" operation. Using of non-film capacitor may generate additional errors.

[2] Specifications are for from 1% to 120% on 2 nF range and ranges from 10% to 120% on other ranges.

Capacitance Measuring

Measurement Method	Measure the rate of change of voltage generated during the current flowing the capacitance
Connection Type	2-wire
Input Protection	1000 V on all ranges

Measure Attentions:

Small capacitance is easily influenced by external noise and thus causes errors while measuring, shielding input can extremely help to reduce this kind of errors.

Other Measuring Characteristics

Triggering and Memory

Samples/Trigger	1 ~ 2000	
Trigger Delay	8 ms ~ 2000 ms optional	
External Trigger Input	Input Level	TTL compatible (High level when left input terminal is hanging in the air)
	Trigger Condition	Rising edge/falling edge selectable
	Input Impedence	>20 kΩ, in parallel with 400 pF, DC-coupled
	Min Pulse	500 μs
VMC Output	Electric Level	TTL compatible (input >=1 kohm loads)
	Output Polarity	straight polarity and negative polarity optional
	Input Impedance	200 ohm, typical

Arbitrary Sensor

Support for multiply types of sensor such as Thermocouple, DC Voltage, DC Current, Resistance (2-wire or 4-wire) and Frequency output; With thermocouple compensation at cold junction.

Output Polarity: straight polarity and negative polarity optional

Preset ITS-90 transform of B, E, J, K, N, R, S and T thermocouple and transform of platinum Pt100, Pt385 resistance temperature sensor

Math Functions

Pass/Fail, REL (RELative), Min/Max/Average, dBm, dB, Hold, Histogram, Standard deviation

History Records

Volatile Memory	2000 readings of history records
Nonvolatile Memory	10 groups of history records (2000 readings/group); 10 groups of sensor records: (1000 readings/group); 10 groups of setting records of instrument; 10 groups of setting records of arbitrary sensor; support USB-disk external storage

General Specifications

Power Supply	
AC 100 V ~ 120 V	45 Hz ~ 440 Hz
AC 200 V ~ 240 V	45 Hz ~ 66 Hz
Consumption	20 VA peak value
Mechanism	
Dimension	107.0 mm×231.6 mm×290.5 mm
Weight	2.5 kg
Other Characteristics	
Display Screen	LCD display with 256×64 lattices, support for Double display, Menu display, Operating help and English/Chinese bilingual.
Operating Environment	Full accuracy from 0℃ to 50℃; 80% R.H. and 40℃, non condensing
	Storage Temperature: -20℃ ~ 70℃
	Shock and Vibration: conforming to MIL-T-28800E, III, 5 level (only for sine)
	height above sea level: up to 3000 meters
Safety	Conforming to IEC61010-1: 2001. Measure CAT I 1000 V/CAT II 600 V Class of pollution: 2
Remote Interface	GPB (only for DM3058), 10/100Mbit LAN (only for DM3058), USB2.0 Full Speed Device 8 (USB-disk available), RS-232C
Programmer Language	RIGOL 3058 SCPI, FLUKE45, Agilent34401A
LXI Compatibility	LXI Class C, Version1.1 (only for DM3058)
Warm Up Time	30 minutes

Ordering Information

Name of Product

RIGOL DM3058/DM3058E Digital Multimeter

Standard Accessories

- A Power Cord that fits the standard of destination country
- Two Test Leads (black and red)
- Two Alligator Clips (black and red)
- An USB Data Cable
- Six Backup Fuses

Optional Accessories

- Kelvin Test Clips
- RS232 Cable

Contact Us

If you have any problem or requirement when using our products or this manual, please contact **RIGOL**.

E-mail: service@rigol.com

Websites: www.rigol.com

Warranty

Thank you very much for choosing **RIGOL** products!

RIGOL warrants that the product mainframe and product accessories will be free from defects in materials and workmanship within the warranty period.

If a product proves defective within the respective period, **RIGOL** guarantees free replacement or repair of any defective products within a reasonable period of time. To get repair service, please contact with your nearest **RIGOL** sales or service office.

There is no other warranty, expressed or implied, except such as is expressly set forth herein or other applicable warranty card. There is no implied warranty of merchantability or fitness for a particular purpose. Under no circumstances shall **RIGOL** be liable for any consequential, indirect, ensuing or special damages for any breach of warranty in any case.

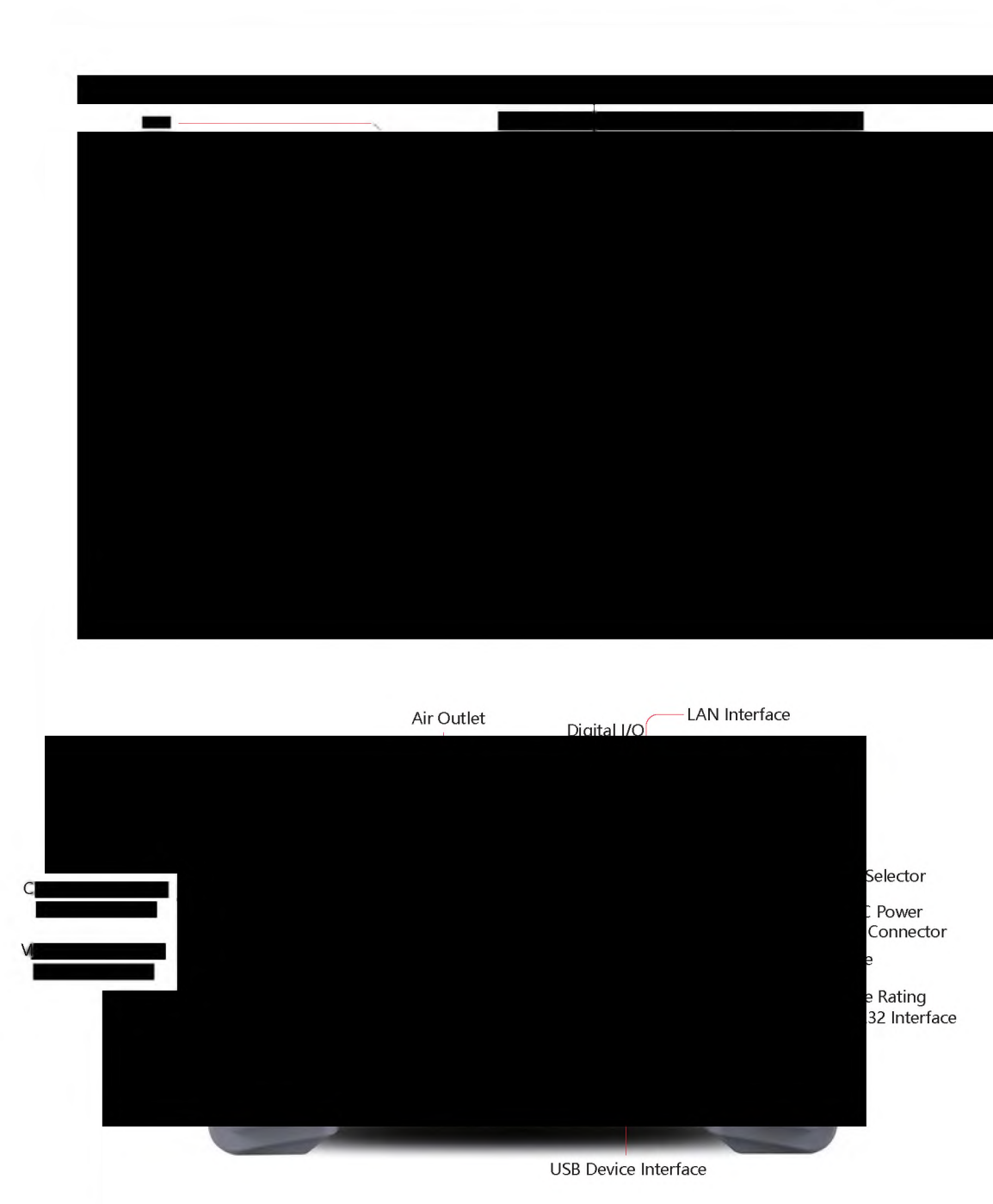
RIGOL



- DL3021/DL3021A: single channel, DC150 V/40 A, total power up to 200 W
- DL3031/DL3031A: single channel, DC150 V/60 A, total power up to 350 W
- DL3041: single channel, DC 200 V/70 A, total power up to 450 W
- Dynamic mode: up to 30 kHz
- Adjustable current rising speed: 0.001 A/μs to 5 A/μs
- Min. readback resolution: 0.1 mV, 0.1 mA
- 4.3-inch TFT LCD, capable of displaying multiple parameters and states simultaneously
- Overvoltage/overcurrent/overpower/overtemperature/reverse voltage protection
- 4 static modes: CC, CV, CR, CP
- 3 dynamic modes: continuous, pulsed, toggled
- List function supports editing as many as 512 steps
- Battery test function, OCP test, OPP test, factory test function, etc.
- Short-circuit test function
- **Power-off memory function**
- Built-in RS232/USB/LAN communication interface
- USB-GPIB module (optional)

DL3000 is a cost-effective programmable DC electronic load with high performance. With a user-friendly interface and superb performance specifications, DL3000 series provides various interfaces for remote communication to meet your diversified test requirements. It can be widely used in various industries, such as automotive electronics, fuel cells, and etc.

► Design Features



► Typical Applications

- General-purpose testing in the R&D lab
- DC power supply industry, such as regulated power supply, constant current power supply, switching mode power supply (SMPS), module power supply, power adapter, etc.
- Battery industry, such as various batteries and cell batteries
- Charger industry, such as battery charger and cell phone charger
- Power electronic device industry, such as MOSFET, IGBT, capacitor, and ballast resistor
- Teaching experiment

► Design Features

30 kHz dynamic mode



Transient test function enables the load to periodically switch between two set levels (Level A and Level B). It can be used to test the transient characteristics of the DUT. The highest frequency can be set to 30 kHz. Besides, in the guide interface, you can configure parameters in the parameter configuration list and view the configuration diagram at the left of the configuration list in the real-time manner.

5 A/μs current rising speed



Current rising speed is defined as the speed of transition from one setting to another. You can set the actual transition time from one setting to another by changing the current rising speed. Adjustable current rising speed: 0.001 A/μs to 5 A/μs.

Powerful list operation function



You can generate complex sequences by editing the setting value for each step, the dwell time, and slew rate (the slew rate can only be edited in CC mode) to meet the complex test demands.

Powerful waveform display function



The electronic load provides the waveform display function and supports the following operations for the waveform, such as pausing the waveform, recording the waveform, and capturing the waveform. Therefore, you can dynamically observe the trend of parameters changes.

Easy-to-use function of file storage and recalling



The load allows you to save different types of files to the internal and external memories. You can recall and read them when necessary.

Sound OVP/OCP/OPP/OTP/Reverse Voltage Protection

When OVP/OCP/OPP/OTP/reverse voltage protection occurs, the load will immediately turn off the input automatically and stop sinking. Then, a prompt message is displayed.

► Specifications

Unless otherwise noted, all specifications are guaranteed within the temperature range of 25°C±5°C with warm-up time of 30 minutes.

DC Input (0°C ~40°C)

Model	Voltage	Current	Maximum Power	Minimum Operating Voltage (DC)
DL3021	0~150 V	0~40 A	200 W	1 V@40 A
DL3021A				
DL3031	0~150 V	0~60 A	350 W	1.3 V@60 A
DL3031A				
DL3041	0 ~ 200 V	0 ~ 70 A	450 W	1.5 V@70 A

CC Mode

Model	Range	Programmable Resolution	Programmable Accuracy ^[1]	Temperature Coefficient ^[2]
DL3021	0~4 A	1 mA	$\pm(0.1\%+0.1\%FS)^{[3]}$	100 ppm/°C
DL3021A	0~40 A		$\pm(0.05\%+0.05\%FS)$	
DL3031	0~6 A	1 mA	$\pm(0.1\%+0.1\%FS)$	100 ppm/°C
DL3031A	0~60 A		$\pm(0.05\%+0.05\%FS)$	
DL3041	0 ~ 7 A 0 ~ 70 A	1 mA	$\pm(0.05\%+0.05\%FS)$	100 ppm/°C

CV Mode^[4]

Model	Range	Programmable Resolution	Programmable Accuracy	Temperature Coefficient
DL3021	0~15 V	1 mV	$\pm(0.05\%+0.02\%FS)$	50 ppm/°C
DL3021A	0~150 V	5 mV	$\pm(0.05\%+0.025\%FS)$	
DL3031	0~15 V	1 mV	$\pm(0.05\%+0.02\%FS)$	50 ppm/°C
DL3031A	0~150 V	5 mV	$\pm(0.05\%+0.025\%FS)$	
DL3041	0 ~ 25 V 0 ~ 200 V	1 mV 5 mV	$\pm(0.05\%+0.025\%FS)$	50 ppm/°C

CR Mode^[5]

Model	Range ^[6]	Programmable Resolution	Programmable Accuracy ^[7]
DL3021	0.08 Ω~15 Ω (0.0667 S~12.5 S)	2 mA/Vsense	Vin/Rset*(0.2%)+0.2%IFS
DL3021A	2 Ω~15 kΩ (0.0000667 S~0.5 S)		
DL3031	0.08 Ω~15 Ω (0.0667 S~12.5 S)	2 mA/Vsense	Vin/Rset*(0.2%)+0.2%IFS
DL3031A	2 Ω~15 kΩ (0.0000667 S~0.5 S)		
DL3041	0.08 Ω~15 Ω (0.0667 S~12.5 S) 2 Ω~15 kΩ (0.0000667 S~0.5 S)	2 mA/Vsense	Vin/Rset*(0.2%)+0.2%IFS

CP Mode^[5]

Model	Range	Resolution
DL3021	0~200 W	100 mW
DL3021A		
DL3031	0~350 W	100 mW
DL3031A		
DL3041	0 ~ 450 W	100 mW

Con Mode

Model	Frequency Range	Frequency Resolution	Frequency Accuracy	Duty Cycle Range
DL3021	0.001 Hz~15 kHz	0.8%	±0.5%	5%~95%, 1%
DL3021A	0.001 Hz~30 kHz			
DL3031	0.001 Hz~15 kHz			
DL3031A	0.001 Hz~30 kHz			
DL3041	0.001 Hz~30 kHz			

Current Slew Rate^[8]

Model	Range	Resolution	Accuracy
DL3021	0.001 A/μs~1 A/μs	0.001 A/μs	5%+10 μs
DL3021A	0.001 A/μs~1 A/μs		
DL3031	0.001 A/μs~1 A/μs	0.001 A/μs	5%+10 μs
DL3031A	0.001 A/μs~1 A/μs		
DL3041	0.001 A/μs~5 A/μs	0.001 A/μs	5%+10 μs

Readback Current

Model	Range	Resolution	Accuracy	Temperature Coefficient ^[2]
DL3021	0 ~ 40 A	1 mA	±(0.1%+0.1%FS)	50 ppm/°C
DL3021A		0.1 mA	±(0.05%+0.05%FS)	
DL3031	0 ~ 60 A	1 mA	±(0.1%+0.1%FS)	50 ppm/°C
DL3031A		0.1 mA	±(0.05%+0.05%FS)	
DL3041	0 ~ 70 A	0.1 mA	±(0.05%+0.05%FS)	50 ppm/°C

Readback Voltage

Model	Range	Resolution	Accuracy	Temperature Coefficient ^[2]
DL3021	0~150 V	0.1 mV	±(0.05%+0.02%FS)	20 ppm/°C
DL3021A				
DL3031	0~150 V	0.1 mV	±(0.05%+0.02%FS)	20 ppm/°C
DL3031A				
DL3041	0 ~ 200 V	0.1 mV	±(0.05%+0.02%FS)	20 ppm/°C

Readback Resistance

Model	Range	Resolution
DL3021	0.08 Ω~15 kΩ (0.0000667 S~12.5 S)	2 mAVsense
DL3021A		
DL3031	0.08 Ω~15 kΩ (0.0000667 S~12.5 S)	2 mAVsense
DL3031A		
DL3041	0.08 Ω~15 kΩ (0.0000667 S ~12.5 S)	2 mAVsense

Readback Power

Model	Range	Resolution
DL3021	0~200 W	100 mW
DL3021A		
DL3031	0~350 W	100 mW
DL3031A		
DL3041	0 ~ 450 W	100 mW

Protection Function

Overcurrent protection (OCP), overvoltage protection (OVP), overpower protection (OPP), overtemperature protection (OTP), as well as local/remote reverse voltage (LRV/RRV) protection.

Stability^[9]

Model	Current	Voltage
DL3021	±(0.01%+10 mA)	±(0.01%+10 mV)
DL3021A		
DL3031	±(0.01%+10 mA)	±(0.01%+10 mV)
DL3031A		
DL3041	±(0.01%+10 mA)	±(0.01%+10 mV)

Input Resistance

350 kΩ

Mechanical	
Dimensions	239 mm(W) x 157 mm(H) x 442 mm(D)
Weight	Net weight: DL3021/3021A/3031/3031A: 7.58 kg DL3041: 7.80 kg
Power	
AC Input (50 Hz~60 Hz)	115 Vac±10%, 230 Vac±10% (max: 250 Vac)
Maximum Input Power	<30 VA
Interface	
USB Device Interface	1
USB Host Interface	1
LAN Interface	1(optional)
RS232	1
Digital I/O	1(optional)
GPIB	1 ((optional, GPIB extended from the USB-GPIB interface module)
Environment	
Cooling Method	Fan Cooled
Operating Temperature	0°C ~40°C
Storage Temperature	-40°C ~70°C
Humidity	5%~80% RH (without condensation)
Altitude	Below 2,000 m
Certification Information	
EMC	Complies with the requirements of the following directive and standards. EMC Directive 2014/30/EU EN 61326-1 EN 61000-3-2 EN 61000-3-3 Under following condition. The maximum length of all connecting cables and wires to the DL3000 series are less than 3 m.
Safety	Complies with the requirements of the following directive and standard. Low Voltage Directive 2014/35/EU EN 61010-1:2010 IP Degree: IP20 Pollution Degree: PD 2 Over Voltage Category: OVC II Operation Location: Indoor use only; not for wet condition

Note^[1]: Data measured after 30-second current sinking at the programming value (applicable to the programming accuracy in CC mode and CV mode).

Note^[2]: **Gain and zero temperature coefficient within the ranges of 0°C~20°C and 30°C~40°C.** For example, at 40°C, the programming accuracy is $\pm[(0.1\%+10^{\circ}\text{C} \cdot 100 \text{ ppm}/^{\circ}\text{C}) \cdot 1\text{A} + (0.1\%+10^{\circ}\text{C} \cdot 100 \text{ ppm}/^{\circ}\text{C}) \cdot 4 \text{ A}]$ under the following conditions: CC mode, 0-4A range, sink current 1 A.

Note^[3]: FS indicates the full scale.

Note^[4]: **The CV mode should be used with a CC source. When using CV + CC source, the current should be limited to 0.2 A; otherwise,** the constant voltage and constant current switching may cause damage to the load.

Note^[5]: **The input voltage/current value should not be smaller than 10% of the full scale.**

Note^[6]: The input voltage for the low range in CR mode should be smaller than 8 V.

Note^[7]: The programming accuracy in CR mode is also determined by the input voltage accuracy.

Note^[8]: **Current slew rate: rising slew rate for 10%~90% of the current (0-maximum current).** Due to design changes, different voltage levels correspond to different maximum current slew rates: 9 V and above: 5 A/μs; 8 V: 4 A/μs; 7 V: 2.5 A/μs; 6 V: 1.25 A/μs; 5 V: 0.5 A/μs; 3 V: 0.2 A/μs.

Note^[9]: Following a steady 30-minute current sinking, change in current/voltage sinking over 8 hours under constant load, line, and ambient temperature.

► Order Information

	Description	Order No.
Model	Programmable DC Electronic Load (single channel, DC 150 V/40 A 200 W 15 kHz 1.0 A/μs)	DL3021
	Programmable DC Electronic Load (single channel, DC 150 V/40 A 200 W 30 kHz 1.0 A/μs)	DL3021A
	Programmable DC Electronic Load (single channel, DC 150 V/60 A 350 W 15 kHz 1.0 A/μs)	DL3031
	Programmable DC Electronic Load (single channel, DC 150 V/60 A 350 W 30 kHz 1.0 A/μs)	DL3031A
	Programmable DC Electronic Load (single channel, DC 200 V/70 A 450 W 30 kHz 5.0 A/μs)	DL3041
Standard Accessories	Power Cord	-
	Either one of the following fuses: · Fuse 50T-0200H 250 V 0.20 A (AC selector: 230 Vac) · Fuse 50T-0315H 250 V 0.315 A (AC selector: 115 Vac)	-
	Shield	-
Software Options^[1]	LAN Interface	LAN-DL3
	Digital I/O Option	DIGITALIO-DL3
	Readback Resolution	HIRES -DL3
	High Frequency Option	FREQ-DL3
Accessories	9-Pin RS232 Cable (female-to-female, cross-over)	CB-RS232-A
	Shield#DL3000#F	SC-DL3
	USB-GPIB Module	USB-GPIB-L
	Sense Cable	CB-SENSE
	20 A Test Lead	CB-20A-780MM
	40 A Test Lead	CB-40A-780MM
	60 A Test Lead	CB-60A-780MM
	80 A Test Lead	CB-80A-780MM
	DL3000 Series Rack Mount Kit (for a single instrument)	RM-1-DP800
	DL3000 Series Rack Mount Kit (for two instruments)	RM-2-DP800

Note^[1]: The A-plus instrument models (DL3021A/DL3031A) and DL3041 have been installed with software options before leaving the factory.

Note:

- When the DUT outputs large currents, please use the specified test leads provided in the optional accessories.
- The color schemes for the interfaces of A-plus instrument models (DL3021A/DL3031A/DL3041) and those models without A (DL3021/DL3031) are different.
- For all the accessories and options, please contact the local office of RIGOL.

► Accessories Description

20 A/40 A/60 A/80 A Test Lead

Model	20 A Test Lead	40 A Test Lead	60 A Test Lead	80 A Test Lead
Maximum Current	20 A	40 A	60 A	80 A
Maximum Voltage	150 V	150 V	150 V	200 V
Terminal	M8/M8	M8/M8	M8/M8	M8/M8
Wire Gauge	AWG14	AWG14×2	AWG14×3	6 AWG
Length	780 mm	780 mm	780 mm	780 mm
Exterior Design				

Sense Cables

Enable the sense function. Then, use the sense cables to connect the sense terminals and the output terminals of the DUT to compensate for the voltage drop caused by the load leads.
Cable length: 780 mm



USB-GPIB Interface Converter

Use the USB-GPIB interface converter to extend the GPIB interface, and then use the GPIB cable to connect the load to the PC to build communication with the PC for remote control.



Shield

For safety considerations, a shield shall be installed.



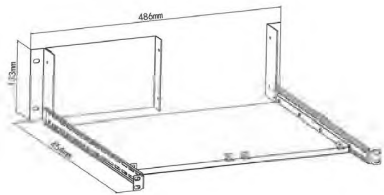
9-Pin RS232 Cable

To realize remote control, use the 9-pin RS232 cable to build communication between the load and the PC via the RS232 interface on the rear panel of the load.



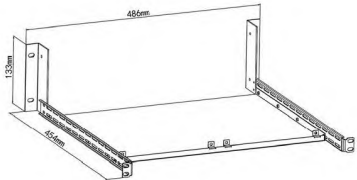
Rack Mount Kit for a single instrument

It is used for installing a single instrument.



Rack Mount Kit for two instruments

It is used for installing two instruments.



Warranty Period

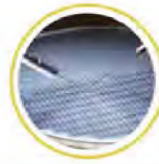
Three years for the mainframe.

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System Integration



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5G Cellular-5G/WIFI
UWB/RFID/ ZIGBEE
Digital Bus/Ethernet
Optical Communication

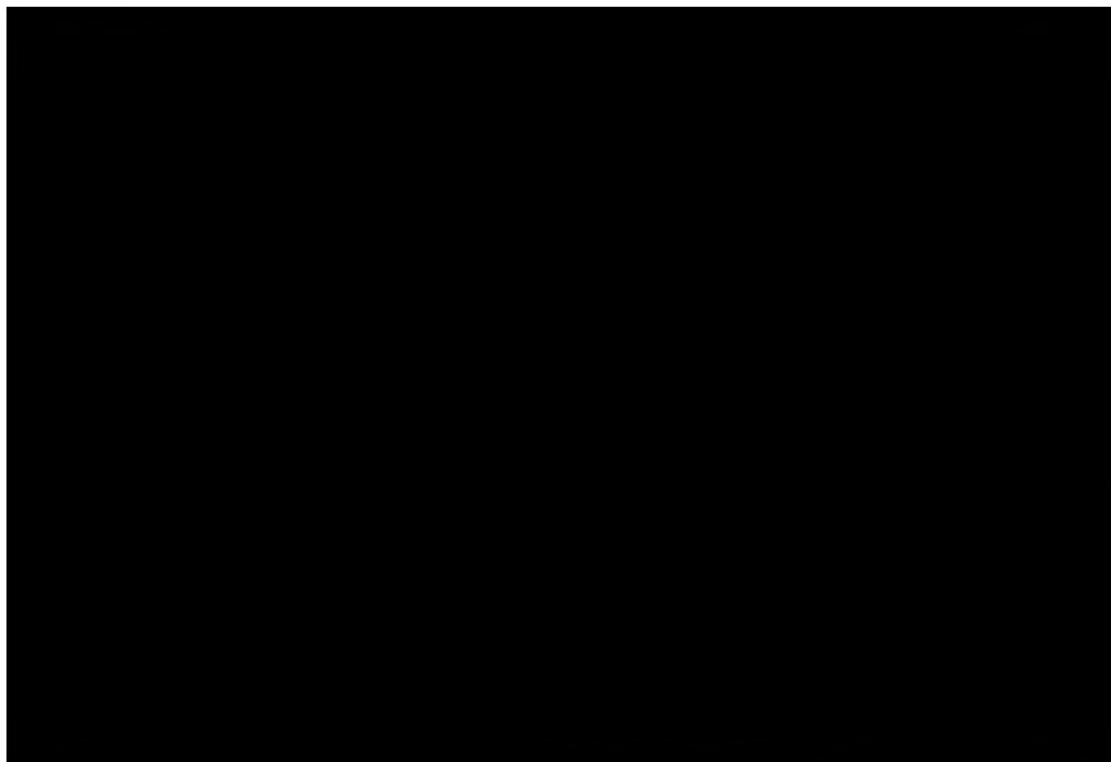
Digital/Analog/RF Chip
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*Provide Testing and Measuring Products
and Solutions for Industry Customers*

Technické údaje

i310s proudová sonda



Klíčové vlastnosti

- Proudové rozsahy: 30 A a 300 A AC(st)_{RMS} nebo ± 45 A a 450 A DC(ss)
- Měřicí rozsahy: ± 45 A a ± 450 A
- Citlivost na výstupu: 10 mV/A (40 A) až 1 mV/A (400 A)
- Rozlišení: ± 50 mA (40 A) až ± 100 mA (400 A)
- Zátěžová impedance: > 10 tis. Ohm a ≤ 100 pF
- Frekvenční rozsah (malý signál): DC(ss) až 20 kHz (-3 dB)
- Fázový posuv pod 1 kHz, < 2 stupně
- Teplotní koeficient: $\pm 0,1$ % z hodnoty/°C
- Napájení: 9 V Alkalická

Přehled výrobků: i310s proudová sonda

Proudová sonda i310s měří AC (st) proud a díky technologii Hall Effect (Hallowých sond), také DC(ss) proud. Proudovou sondu i310s lze používat v kombinaci s osciloskopy a dalšími vhodnými záznamovými přístroji pro přesné měření proudu bez nutnosti rozpojení obvodu.

Technické údaje: i310s proudová sonda

Elektrická charakteristika

Proudové rozsahy	30 A a 300 A AC(st) _{RMS} nebo ±45 A a 450 A DC(ss)
AC(st) _{RMS} nebo DC(ss)	± 45 A a 450 A
Náběhový proud	600 A AC(st) _{RMS} MAX
Citlivost na výstupu	10 mV/A (30 A)
	1 mV/A (300 A)
Přesnost (při +23 °C)	(rozsah 30 A) ± 1 % z hodnoty ± 50 mA
	(rozsah 300 A) ± 1 % z hodnoty ± 300 mA
Šíře pásma odpovídající specifikaci přesnosti	1 kHz
Fázový posuv pod 1 kHz	< 2 stupně
Rozlišení	± 50 mA (30 A)
	± 100 mA (300 A)
Zátěžová impedance	> 10 tis. Ohm a ≤ 100 pF
Citlivost na pozici vodiče	± 1,5 % vztahující se ke střední hodnotě
Frekvenční rozsah	(malý signál) DC(ss) až 20 kHz (-3 dB)
Teplotní koeficient	± 0,1 % z hodnoty/°C
Napájení	9 V Alkalická, MN1604/PP3
Životnost baterií	30 hodin, indikátor vybití baterie
Pracovní napětí (viz část Bezpečnostní standardy)	300 V AC(st) _{RMS} nebo DC(ss)

Obecná charakteristika

Maximální rozměr vodiče	průměr 19 mm
Výstupní připojení	Bezpečnostní konektor BNC
	Dodává se s 4mm bezpečnostním adaptérem
Nulování výstupu	Ruční nastavení - otočným palcovým ovladačem
Délka kabelu	2 metry

Rozsah provozní teploty	-10 až +50 °C
Rozsah teploty skladování (bez baterie)	-20 °C až +85 °C
Provozní vlhkost	15% až 85% rel. vlhkost (nekondenzující)
Hmotnost	250 g
Bezpečnost	IEC 61010-1, stupeň znečištění 2
	IEC 61010-2-032: CAT III 300 V
	Použití sondy na neizolovaných vodičích se omezuje na 300 V AC RMS nebo DC a frekvence do 1 kHz.
Kompatibilita EMC	IEC 61326-1: Přenosný, elektromagnetické prostředí

Modely



i310s

Proudové kleště AC/DC

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11/2025

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písemného schválení společnosti Fluke Corporation.**



Specifikace předmětu plnění

„Dodávka elektro-vybavení laboratoří pro budovu DFJP DD“.

Položka 1 – Dvoukanálový generátor – 5 ks **AIM-TTI TGF4082**

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- dvoukanálový funkční generátor ve frekvenčním pásmu min. od 0,001 MHz až do alespoň 80 MHz - s rozlišením 1 μ Hz nebo lepším,
- frekvenční rozsah: 1 μ Hz-80 MHz nebo širší,
- výstupní úroveň: od 10 mVpp; minimálně do 10 Vpp /50 Ω ,
- počet kanálů: 2 kanálový, nezávislé na sobě,
- splnění požadavků dle IEC (či EN) 61010 -1 – CAT II, dále EN 61326-1 ^{1*)}
- celkové harmonické zkreslení: nejvýše 0.05%,
- externí modulační vstup: AM; FM; PM a PWM,
- LCD display: velikost minimálně 4“; minimálně 480 x 272 pixel a minimálně 250 000 barev,
- generátor musí umožňovat nastavení tvaru signálu: arbitrární; trojúhelník; pulz; sinusový; obdélníkový; šum; Lorenzova křivka; modulace: AM, FM, PŠM,
- požadujeme rozhraní: USB interface; USB flash; min LAN (LXI), možnost volitelného GPIB,
- požadujeme 2x kabel BNC/BNC, impedance 50 Ohm.

Položka 2 – LCR metr – 4 ks **GW Instek LCR-6002**

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- měřicí přístroj LCR s frekvenčním pásmem minimálně od 10 Hz do 100 kHz, avšak minimálně 2 kHz s možností nastavení libovolné měřicí frekvence z rozsahu,
- testovací úroveň signálu je požadována:
 - u AC minimálně: od 10 mV do 2 V / od 100 μ A do 20 mA,
 - u DCR 2 V DC,
- rozsahy měření:
 - a) odpory od 0,00001 Ω až do 99999,9 k Ω ,
 - b) kapacita od 0,00001 pF až do 9999,99 mF,
 - c) indukčnost od 0,00001 μ H až do 9999,99 H,
 - d) vodivost od 0,00001 Ω až do 99,9999 M Ω ,
 - e) činitel kvality od 0,00001 až do 99999,9,
 - f) ztrátový činitel od 0,0001 až do 9,99999,
- přesnost: nejvýše 0,05%,



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Příloha č. 2a Výzvy k podání nabídek

- paměť: interní paměť: minimálně 10 000 souborů s měřením (formát CSV); USB flashdisk: minimálně 9 999 souborů s měřením (formát CSV); minimálně 999 snímků obrazovky,
- volitelná výstupní impedance 30 Ω /50 Ω /100 Ω ,
- velikost a typ displeje min. 3,5“, LCD TFT rozlišení alespoň 320x240 pixelů, RGB, musí umožňovat zobrazení až 4 parametrů,
- rozhraní RS-232C (SCPI) a USB.

Položka 3 – Stolní multimetr – 4 ks Keysight EDU34450A

Celé zařízení musí splňovat následující minimální technické požadavky a obsahovat následující součásti:

- stolní multimetr s velkým barevným displejem o velikosti alespoň 7",
- počet číslic: minimálně 5,5,
- měření AC proudu: minimálně 3 A,
- měření AC napětí: minimálně 750 V,
- měření DC napětí: minimálně 1 kV,
- měření rezistence: minimálně 100 M Ω ,
- měření DC Proudu: minimálně 3 A,
- rozhraní: LAN, USB,
- požadujeme: měření proudu AC, DC; měření napětí AC, DC; měření frekvence, měření diod, měření frekvence a měření teploty,
- měřicí rozsahy měření napětí DC (100 mV, 1 V, 10 V, 100 V, 1 kV),
- je požadována přesnost měření napětí DC: $\pm (0,015\% \text{ z měřené hodnoty} + 0,005\% \text{ rozsahu})$,
- měřicí rozsahy u měření napětí AC: (100 mV/1 V/750 V),
- rozsah měření proudu AC v rozsahu minimálně od 10 mA do 3 A (minimálně) s přesností pro DC $\pm (0,10\% \text{ údaje} + 0,007\% \text{ rozsahu})$ a AC $\pm (0,5\% \text{ údaje} + 0,1\% \text{ rozsahu})$,
- přístroj musí umět měřit hodnotu True RMS AC,
- pro měření odporu jsou požadovány rozsahy: 100 Ω /1 k Ω /10 k Ω /100 k Ω /1 M Ω /10 M Ω /100 M Ω s přesností měření $\pm (0,065\% \text{ změřené hodnoty} + 0,005\% \text{ rozsahu})$,
- rozsah měření kmitočtu od minimálně od 20 Hz do 300 kHz (minimálně) s přesností měření kmitočtu $\pm (0,025\% + 3 \text{ digity})$,
- splnění požadavků dle IEC (či EN) 61010 -1 – CAT I 1000V, CAT II 300V^{1*)}



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Příloha č. 2a Výzvy k podání nabídek

Položka 4 - Osciloskop – 4 ks RIGOL DHO804

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- 4 - kanálový číslicový osciloskop v pásmu kmitočtů minimálně do 50 MHz,
- počet kanálů: minimálně 4,
- pásmo: minimálně 50 MHz,
- vzorkování: minimálně 1 Gsps,
- délka paměti záznamu: minimálně 10 Mpts,
- display: barevný, minimálně 7", minimálně 800x480; minimálně 256 barev,
- rozsahy časové základny: minimálně 5ns/dílek – 100 s/dílek,
- max. vstupní napětí minimálně 300 V,
- splnění požadavků dle IEC (či EN) 61010 -1 – CAT I nebo CAT II^{1*)}
- vertikální rozlišení: minimálně 8 bit,
- vstupní impedance: 1 MΩ/16 pF,
- vstupní citlivost: minimálně 1mV/dílek,
- rozhraní: LAN; USB,
- činnost v režimu X-Y,
- požadujeme režim FFT.

Položka 5 – Programovatelná elektronická zátěž – 4 ks GW Instek PEL-503-80-50

Celé zařízení musí splňovat následující minimální technické požadavky a parametry:

- stejnosměrná elektronická zátěž pro napětí od 0 V do 80 VDC (minimálně),
- pracovní rozsah napětí: minimálně od 1,0 V do minimálně 80 V,
- výkon: minimálně 250 W,
- musí být schopno pracovat v režimech CC, CR, CV, CP, OPP, OCP, OVP a OTP,
- u CC modu: je požadováno nastavení proudu minimálně do 50 A, přesnost nastavení: $\pm 0,1 \%$ z nastavení a rozsahu,
- u CR modu: je požadováno nastavení odporu minimálně v rozsahu 1 Ohm do 96000 Ohm, přesnost nastavení: $\pm 0,2 \%$ z nastavení a rozsahu,
- u CV modu: je požadováno nastavení napětí minimálně od 0 do 80 V, přesnost nastavení: $\pm 0,05 \%$ z nastavení a rozsahu,
- LCD display,
- rozhraní: RS 232, USB.

Položka 6 - Spektrální analyzátor včetně software – 2 ks UNI-T UTS3015T+ + sw UTS3000-AMA

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:



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Příloha č. 2a Výzvy k podání nabídek

- frekvenční rozsah 9 kHz až 1 GHz nebo rozsah širší
- rozlišení minimálně 1 Hz nebo lepší,
- musí umožňovat použití: tracking generátoru,
- rozsah RBW filtru analyzátoru od minimálně 10 Hz do minimálně 1 MHz
- tracking generátor: ve frekvenčním rozsahu od 100 kHz do frekvence odpovídající maximální hodnotě frekvenčního rozsahu přístroje nebo lepší,
- citlivost: minimálně – 148dBm/Hz (typická pro režim: PreAmp On),
- funkce: vestavěná AM/FM demodulace, požadujeme možnost nastavení hloubky modulace minimálně od 5% do 95% s modulačním kmitočtem minimálně od 20 Hz do 100 kHz,
- požadujeme vestavěný minimálně 20 dB předzesilovač,
- RF vstup: impedance 50 typicky, konektor N type,
- tracking generátor výstup: impedance 50 Ohm a konektor N,
- rozhraní: LAN, USB,
- LCD display s rozlišením minimálně 800x600 o velikosti minimálně 10“.

Položka 7 - Multimetr pro měření True RMS – 4 ks Keysight U1232A

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- ruční multimetr s DCV přesností lepší než 0.5% + 2 counts,
- ruční/automatické přepínání rozsahu multimetru,
- minimální stupeň krytí IP42 nebo lepší,
- napájení článků typu AAA nebo AA a indikaci stavu baterií,
- musí umožňovat měření napětí AC a DC; měření odporu, frekvence a kapacity, musí umožnit testování polovodičových diod,
- rozsah měření napětí DC: minimálně od 600 mV a minimálně do 600 V,
- rozsah měření napětí AC: minimálně od 600 mV a minimálně do 600 V,
- rozsah měření proudu DC: minimálně od 60 μ A a minimálně do 10 A,
- rozsah měření proudu AC: minimálně od 60 μ A a minimálně do 10 A,
- rozsah měření proudu kapacity: minimálně od 1000 nF a minimálně do 10 mF,
- je požadován rozsah měření odporu: minimálně od 600 Ω a minimálně do 60 M Ω .

Položka 8 - Multimetr ruční – 4 ks UNI-T UT133A

Celé zařízení musí splňovat následující minimální technické požadavky a parametry a obsahovat následující součásti:

- ruční multimetr musí umožňovat měření napětí AC a DC; měření odporu, frekvence a kapacity, musí umožnit testování polovodičových diod,
- rozsah měření napětí DC: 600 mV/6 V/60 V/600 V,
- rozsah měření napětí AC: 600 mV/6 V/60 V/600 V,



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Příloha č. 2a Výzvy k podání nabídek

- rozsah měření proudu DC: 600 μ A/60 mA/600 mA/minimálně 10 A,
- je požadován rozsah měření odporu: 600 Ω , 6 k Ω , 600 k Ω , 60 M Ω .

Dodávka přístrojů musí obsahovat dopravu do místa plnění a dále uživatelské příručky, návody a veškerou další dokumentaci potřebnou k provozování zařízení, a to v českém nebo anglickém jazyce.

1*) Pokud se v zadávacích podmínkách vyskytnou technické podmínky (normy), je účastník oprávněn navrhnout jiné řešení splňující rovnocenným způsobem požadavky vymezené takovými technickými podmínkami. Tuto skutečnost dodavatel prokáže ve své nabídce, a to zejména technickou dokumentací výrobce nebo zkušebním protokolem vydaným uznaným orgánem. Uzanými orgány se rozumí zkušební a kalibrační laboratoře nebo certifikační a inspekční orgány splňující platné evropské normy.



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Measurably better value



Sine frequency up to 240MHz with 1 μ Hz resolution

Up to 100MHz high resolution pulse generator

Arbitrary waveforms up to 16bits at 800MSa/s

Wideband noise generator



TGF4000 SERIES

40MHz, 80MHz, 160MHz & 240MHz

Dual Channel Arbitrary Function Generators

EXTENSIVE FEATURES

Sine frequency up to 240MHz
high sine purity, THD <0.05%

Full 10Vpp amplitude into 50Ω
for sine waves up to 80MHz

Arbitrary waveforms of 16 bits
at up to 800MSa/s

Class-leading modulation set
including SUM* modulation

Harmonics generation using
up to 16 harmonics*

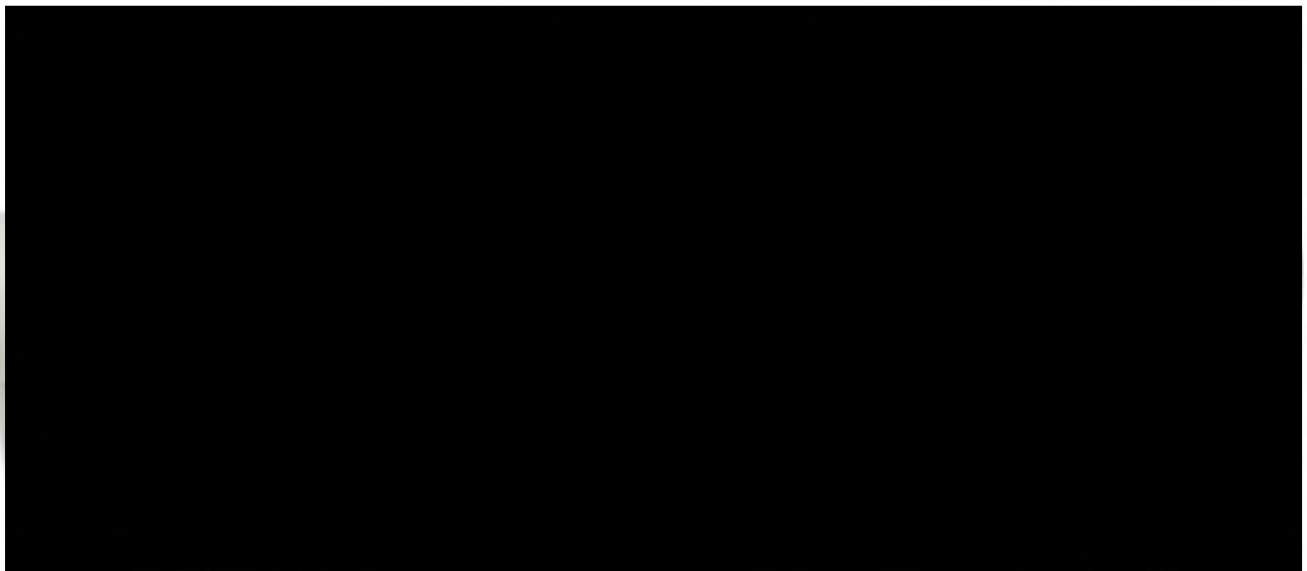
Two identical channels with phase
control, coupling and tracking

Up to 100MHz high resolution
pulse generator

PRBS serial patterns with eight
selectable sequence lengths*

125MHz frequency counter/timer
with five measurement modes

Wide bandwidth noise source



The TGF4000 series is the latest function/arbitrary generator series from Aim-TTi offering class-leading performance and unrivalled value for money.

A frequency capability of up to 240MHz is combined with two identical full performance channels that can operate as independent generators or in coupled or tracking modes. Precise channel to channel phase control with a resolution of 0.001° is provided.

A wide range of built-in waveforms is included and custom arbitrary waveforms can be used at sample speeds up to 800MSa/s and replay rates up to 80MHz. PC based arbitrary waveform generation and editing software is provided.

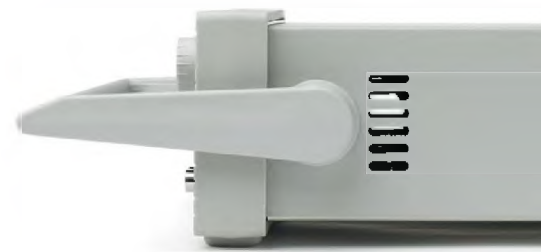
High resolution, low jitter pulses can be generated up to 100MHz as can wide bandwidth white noise.

An extensive array of modulations is provided using internal and external sources. Gated, burst and sweep modes can use internal or external trigger sources.

Remote control via USB and LXI compliant LAN (standard) can be supplemented by optional GPIB if required.

FEATURES SUMMARY

- ▶ 0.001mHz to 240MHz (TGF4242), 160MHz (TGF4162) , 80MHz (TGF4082) or 40MHz (TGF4042) sine frequency range
- ▶ High sine wave purity with low phase noise and jitter, audio band THD down to 0.05%
- ▶ Square waves up to 100MHz with variable duty cycle, edge speeds down to 3ns
- ▶ Resolution of up to 15 digits or 1μHz, high stability TCXO timebase
- ▶ Two identical channels - independent or linked with coupled and tracking modes
- ▶ Inter-channel phase offset of -360° to +360° with 0.001° resolution
- ▶ 1mHz to up to 100MHz Pulse generation with 100ps width resolution, <30ps jitter, and independently variable rise/fall times
- ▶ Wideband noise generator with up to 100MHz noise bandwidth
- ▶ PRBS pseudo-random bit sequence generation with 8 sequence lengths *
- ▶ Harmonics generation using up to 16 harmonics *
- ▶ Wide range of standard and arbitrary waveforms built-in
- ▶ Arbitrary waveforms of 14-bits / 400MSa/s (TGF4042 & TGF4082) or 16-bits / 800MSa/s (TGF4162 & TGF4242)
- ▶ Waveform Manager Plus for Windows, editing software included
- ▶ Front USB host socket for waveform storage and file transfers using Flash drives
- ▶ Comprehensive internal/external digital and analog modulation set including Sum* modulation
- ▶ Modulation frequencies up to 10MHz internal and 5MHz external
- ▶ Gate and Burst modes with internal and external triggering
- ▶ Bi-directional linear and logarithmic sweep using internal or external triggering
- ▶ 125MHz frequency counter/timer with five measurement modes
- ▶ Programmable via USB and LAN (LXI) interfaces; GPIB optional



Features marked * are only available on the TGF4162 & TGF4242

EXCEPTIONAL PERFORMANCE

MODEL COMPARISON	TGF4042	TGF4082	TGF4162	TGF4242
No. of channels	2	2	2	2
Max frequency (sine)	40MHz	80MHz	160MHz	240MHz
Max frequency (square/ pulse)	25MHz		100MHz	
Vertical bits / Sample rate	14 bits / 400Msa/s		16 bits / 800Msa/s	
Noise bandwidth	50MHz		100MHz	

HIGHER FREQUENCIES

The TGF4000 Series out-performs other generators in its price range by offering high purity sine waves up to 240MHz and square waves up to 100MHz, with low harmonic distortion and low phase noise, audio band THD is significantly better than similar generators at just 0.05%.

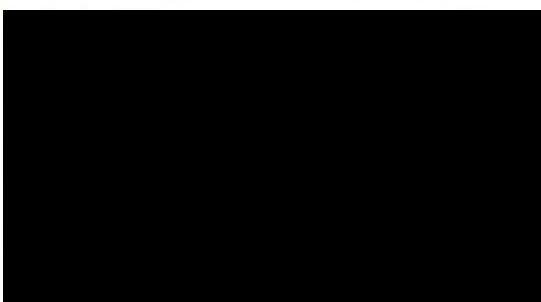
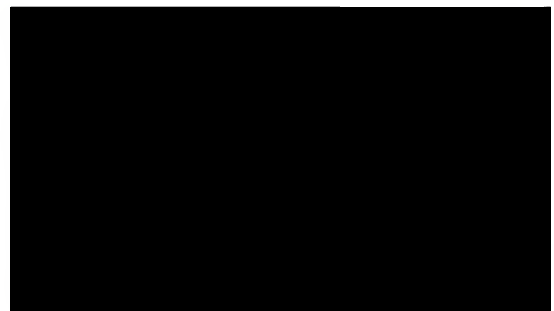
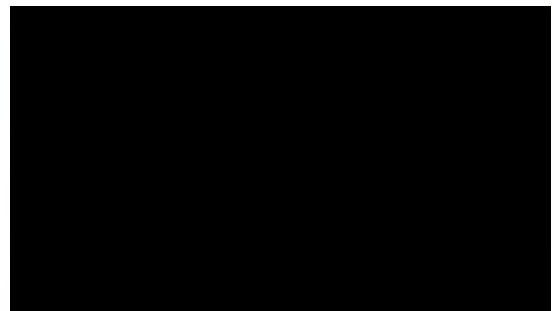
EXCEPTIONAL FREQUENCY PRECISION

The frequency of these waveforms can be set with up to 15 digits or one micro hertz of resolution.

The DDS based frequency generation system uses a high stability TCXO timebase oscillator.

HIGH FREQUENCY AND RESOLUTION PULSE

The pulse generator function offers an exceptionally high pulse width resolution of 100ps over a period range from 10ns to 1000s. The pulse edge speed is independently variable from 3ns to 800s. Pulse jitter is dramatically lower than any comparable generator at only 30ps.



PRBS

PRBS (Pseudo-Random Bit Sequence) is a binary waveform type that is widely used within secure communications systems. PRBS is offered with a choice of 8 sequence lengths at rates between 1mbps and 100Mbps.

PRBS can be used as both a carrier waveform and a modulation.

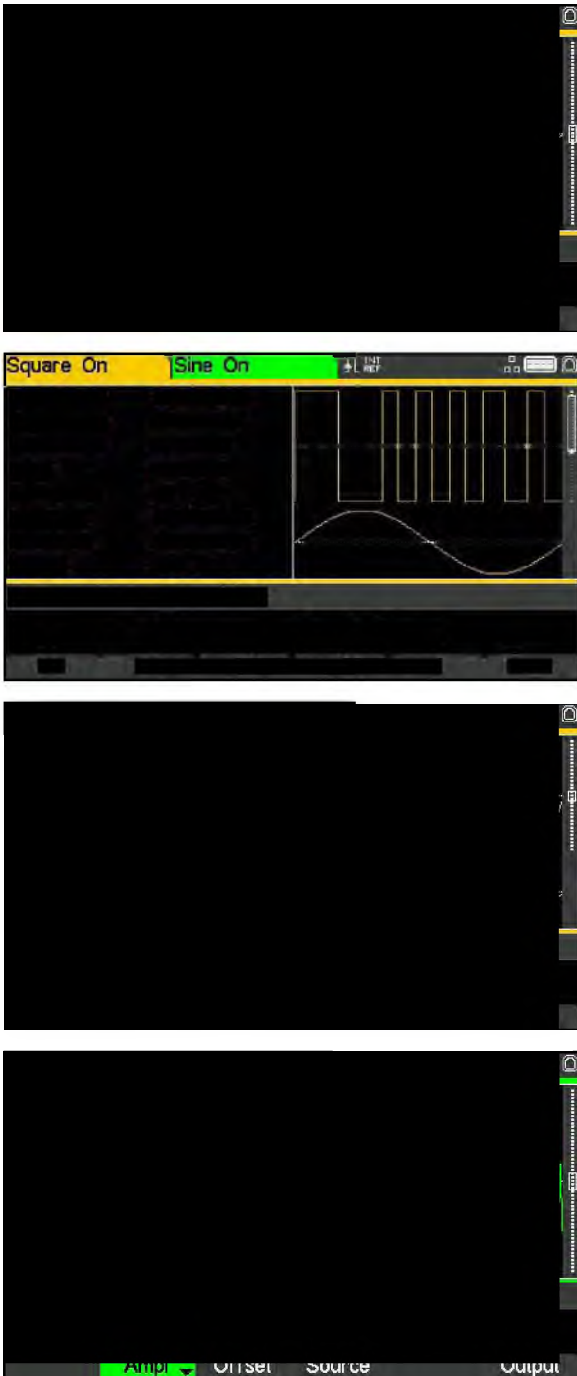
HARMONICS GENERATOR *

The harmonics generator function built into the TGF4000 series enables waveforms to be created by the addition of sine wave harmonics.

Up to 16 harmonics can be used, chosen from up to the 50th order. The amplitude and phase can be individually set for each harmonic.

FREQUENCY COUNTER/TIMER

The frequency counter function allows external signals to be measured in terms of frequency, period, pulse width or duty cycle. The frequency range is 0.1Hz to 125MHz with a measurement resolution of up to seven digits. Both generator channels remain operational when the counter is in use.



EXTENSIVE DIGITAL & ANALOG MODULATIONS

A large set of modulation types are built-in including AM, FM, PM, FSK, ASK, BPSK, PWM and SUM.

All standard and arbitrary waveforms can be modulated as the carrier, although Noise, Pulse and PRBS are limited to AM, ASK and SUM modulations plus PWM for Pulse.

INTERNAL DIGITAL MODULATIONS

AM, FM, PM, PWM and SUM modulations can use an internal modulation source based upon any standard or arbitrary waveform type or Noise. A very wide modulation frequency range of 1 μ Hz to 10MHz can be used.

FSK, ASK, and BPSK use a square wave modulation signal adjustable between 2mHz and 10MHz.

EXTERNAL ANALOG MODULATION AND TRIGGERING

All modulation types can use an external modulation signal, either analog (AM, FM, PM, PWM and SUM) or digital triggering (FSK, ASK, and BPSK).

The analog modulation input bandwidth is DC to 5MHz.

SUM MODULATION *

SUM modulation, not offered by most other products, enables the modulation waveform to be added to the carrier at any percentage.

All waveform types including Pulse and PRBS can be SUM modulated. This is particularly useful using Noise as the modulator to test circuit resilience with noisy signals.

WIDEBAND NOISE GENERATOR

The Noise function provides wideband gaussian noise at bandwidths up to 100MHz and crest factor of more than five. Noise can be used both as a carrier waveform and as a modulating waveform for AM, FM, PM, PWM and SUM modulation types. As a carrier it can be AM, ASK or SUM modulated.

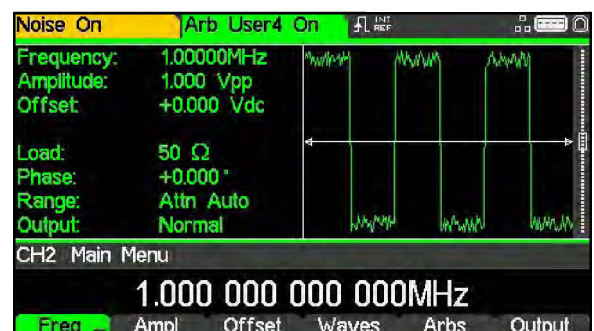
BUILT-IN WAVEFORMS

A large number of standard and pre-built arbitrary waveforms are built into the generator. These include triangles, ramps, sinc, logarithmics, exponentials, gaussians and cardiac (among others).

High sampling rate allows higher repetition rates than other generators.

CUSTOM ARBITRARY WAVEFORMS

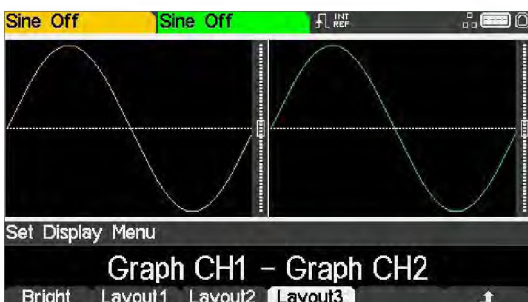
Custom arbitrary waveforms of 16 bit vertical resolution and up to 8192 points can be defined and replayed at sampling rates up to 800MS/s and repetition rates up to 80MHz.



EFFICIENT WORKING

GRAPHIC USER INTERFACE (GUI)

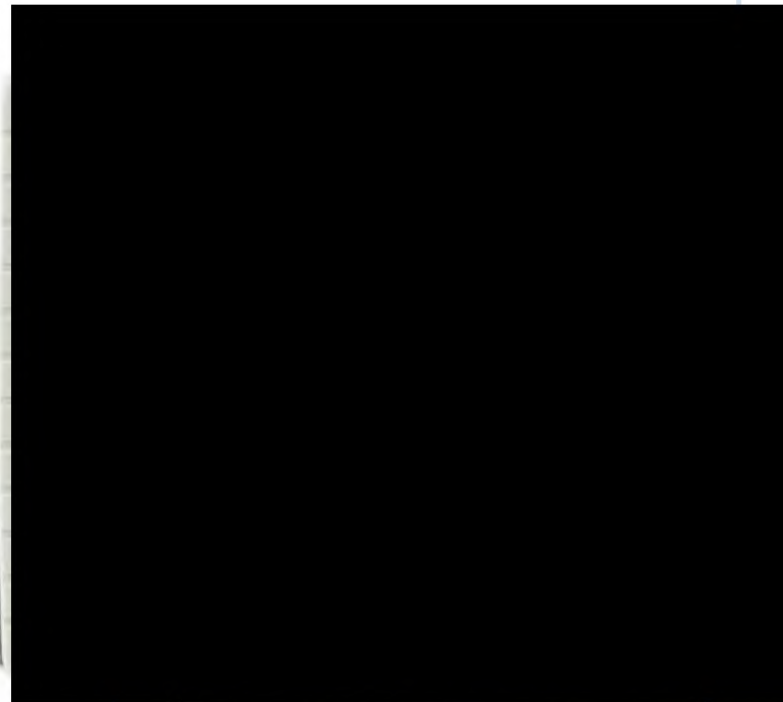
The TGF4000 series is equipped with a 4.3 inch high resolution colour screen, providing added efficiency and clarity when carrying out complex testing. The graphic display demonstrates a quick visual insight into the waveform through the specifically colour coded graph, ensuring accurate and reliable results. Graphs for both channels can be displayed side by side for easy comparison or alongside a detailed description of the settings selected. Each channel has a unique set colour to provide instant recognition of the output channel selected when altering and updating settings or preferences.



UNLIMITED WAVEFORM STORAGE

Flash drives can be used both to store waveforms permanently and to transfer waveforms from or to a PC.

The TGF4000 series is capable of storing up to four arbitrary waveforms internally, each flash drive can store up to 1000 waveforms which can be accessed using the instruments file handling facilities.



FLASH DRIVE

A front mounted USB host socket enables the use of flash memory disk drives which can store up to 1,000 waveforms and 1,000 setups.

STORAGE OF INSTRUMENT SET-UPS

Up to nine complete set-ups of the instrument can be stored within its own non-volatile memory. Up to 1000 further set-ups can be stored on each flash drive.

TWO CHANNEL OPERATION

The two channels are identical with no performance limitations giving maximum flexibility and value for money.

► INDEPENDENT CHANNEL OPERATION

The two channels can be operated completely independently as if they were two separate generators. (Note that external trigger and external modulation inputs are shared).

► RELATIVE PHASE

The relative phase can be set from -360 degrees to +360 degrees with 0.001° resolution. Pressing the 'align' key phase synchronises the two channels with the specified phase offset.

► COUPLED OPERATION

The frequencies of the two channels can be coupled such that changes on one are applied to the other.

Amplitudes (and DC offsets) of the two channels can be coupled such that changes are applied to both simultaneously. Outputs can be coupled such that the output on/off switches both channels simultaneously.

► TRACKING OPERATION

When in tracking mode both channels behave as one channel. If inverse tracking is selected, both channel still behave as one channel except that the output of channel 2 is inverted.

► SYNC OUTPUT

Channel 2 can be configured to be a Sync output for channel 1.

GATE, BURST & SWEEP

Comprehensive facilities for gating, burst triggering and frequency sweeping of signals are provided.

► TRIGGER SIGNAL

The trigger signal can be manual from the front panel key, internal from the internal trigger generator, external from the trigger-in socket, or remote via a bus command. It can be used for gating, triggered burst or triggered sweep. The internal trigger generator is adjustable between 2mHz and up to 50MHz.

► TRIGGERED BURST

In Burst mode, each active edge of the trigger will produce one burst of the waveform. The number of cycles in a burst can be set between 1 and 2,147,483,647 (or infinite). The burst start/end phase angle is settable between -360.0° to +360.0° to 0.001° resolution.

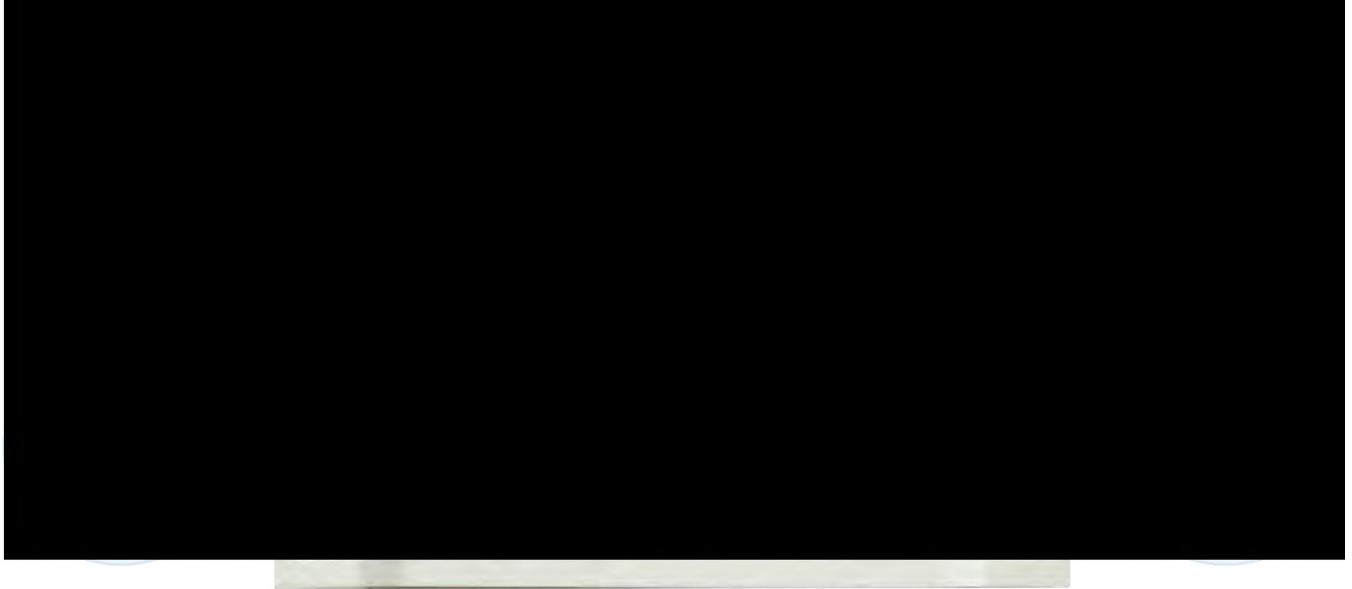
► SWEEP

Phase continuous sweep is available for all standard and arbitrary waveforms except for Pulse, PRBS and Noise. The sweep range is from 1μHz through to the maximum for the chosen carrier waveform. Start and stop frequencies can be set independently. The sweep can be linear or logarithmic, triggered or continuous with a period between 1μs and 500s.

► GATING

In gated mode Waveform will run while the gate signal is true and stop while false. The start/stop phase is settable between -360.0° to +360.0° to 0.001° resolution.

ENHANCED CONNECTIVITY



FULL REMOTE CONTROL

All functions of the generators can be controlled from the digital interfaces. Arbitrary waveform data can also be loaded using these interfaces.

LAN

The LAN interface uses a standard 10/100 base-T Ethernet hardware connection with ICMP and TCP/IP Protocol for connection to a Local Area Network or direct connection to a single PC. This interface supports LXI and is highly appropriate for system use because of its scalable nature and low cost interconnection.

LXI

The LAN interface is LXI compliant. LXI (LAN eXtensions for Instrumentation) is the next-generation, LAN-based modular architecture standard for automated test systems managed by the LXI Consortium, and is expected to become the successor to GPIB in many systems. For more information on LXI go to:

www.aimtti.com/go/lxi

GPIB (OPTIONAL)

The GPIB interface is compliant with IEEE-488.1 and IEEE-488.2. GPIB remains a widely used interface for system applications.

USB

USB provides a simple and convenient means of connection to a PC and is particularly appropriate for small system use. A USB driver is provided which supports Windows 2000 and above including Win 8 and 10.

LABVIEW & IVI DRIVER

An IVI driver for Windows is included. This provides support for common high-level applications such as LabView*, LabWindows*, and Keysight VEE*.

WEB INTERFACE

The TGF4000 has a built-in LXI compliant web server which provides information on the unit and allows it to be configured over the LAN, quickly allowing the unit to be controlled via PC or tablet at no extra cost. Simple command line control from the browser is also possible.

WAVEFORM SOFTWARE

Both generators are supplied with Waveform Manager Plus software for Windows.

This PC software enables complex arbitrary waveforms to be created and edited.

Waveforms can be built in any number of sections using any combination of standard waveforms, mathematical expressions, drawn waveforms, uploaded waveforms, imported waveforms and existing stored waveforms.

Waveforms can be transferred to the generator using either the Flash drive interface or the bus interfaces.

FREQUENCY REFERENCE

The generators use a high quality TCXO crystal as the internal frequency reference providing 1ppm accuracy and stability.

If a higher accuracy or stability is required, an external 10MHz reference signal (from an off-air standard for example) can be applied to the Ref. Clock input.

The internal 10MHz clock is available as a rear panel output for synchronisation with external equipment.

OTHER INPUTS

In addition to the Reference Clock input and output sockets, rear panel inputs for Modulation and Trigger are provided.

These are used both for the modulation and triggering/gating functions and for the external frequency counter function.

SYNC OUTPUT

Channel 2 can be configured to be a Sync output for channel 1.

Sync can be chosen to perform a variety of tasks depending upon the waveform type and the application.

MAIN OUTPUTS

The main outputs can provide up to 10V pk-pk into 50Ω (20V pk-pk EMF) for frequencies up to 80MHz.

Maximum amplitude is reduced for higher frequencies.

High levels of DC offset can be set in conjunction with low signal levels, and the attenuator can be fixed to prevent glitches when changing levels.

Amplitudes can be entered as peak to peak voltage plus offset or in terms of high level and low level

The amplitudes are shown relative to a 50Ω load impedance or as the open circuit EMF values.

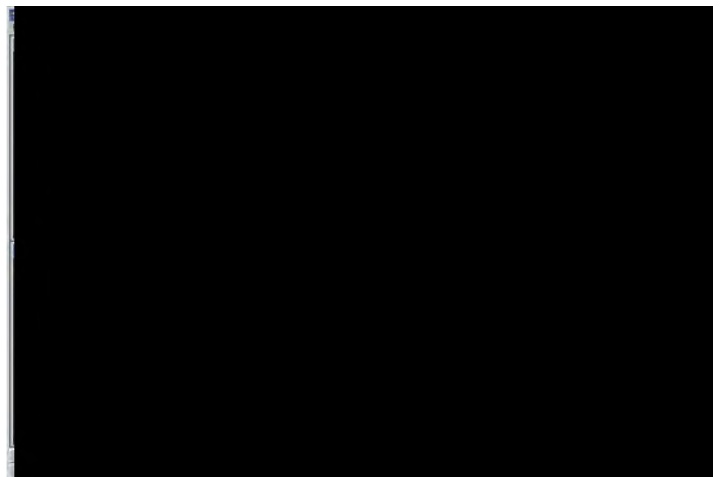
Alternatively the user can enter any load value between 1Ω to 10kΩ and the amplitude will be calculated accordingly.

WAVEFORM EDITING

Basic waveform creation and editing is built into the generator. However for complex waveforms Waveform Manager Plus software is included. This Windows based package enables almost any waveform shape to be created using mathematical expressions, freehand drawing, waveform libraries, and import of waveforms using the Clip Board.

WAVEFORM TRANSFER AND STORAGE

Waveforms can be stored on Flash drives using the front panel mounted USB host interface. Waveforms can be transferred from or to a PC either using a Flash drive, or via the digital interfaces (USB, LAN or GPIB).



ACCESSORIES

Rack Mounting

For system applications the generators can be rack mounted.

With the protective moldings and handle removed the size is half rack width by 2U high.

A 2U rack mounting kit is available suitable for one or two instruments.

TECHNICAL SPECIFICATIONS

MODEL:		TGF4042	TGF4082	TGF4162	TGF4242
WAVEFORMS:					
Standard waveforms:		Sine, Square, Ramp (Variable Symmetry), Triangle (50% Ramp symmetry), Positive Ramp (100% Ramp symmetry), Negative Ramp (0% Ramp symmetry), Pulse, Noise (Gaussian), DC, Sin(x)/x, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Cardiac, Gaussian, Lorentz, D-Lorentz and 4 User Defined Arbitrary Waveforms. Dozens of useful pre-built arbitrary waveforms are also supplied on Website.			
		-		PRBS	
SINE :					
Frequency range:		1μHz to 40MHz	1μHz to 80MHz	1μHz to 160MHz	1μHz to 240MHz
Frequency resolution:		1μHz, 14 digits		1μHz, 15 digits	
Output level (into 50Ω) :		10mVp-p to 10Vp-p			
	≤50MHz		10mVp-p to 10Vp-p		
	≤80MHz		10mVp-p to 5Vp-p	10mVp-p to 10Vp-p	10mVp-p to 10Vp-p
	≤120MHz			10mVp-p to 5Vp-p	10mVp-p to 5Vp-p
	≤240MHz			10mVp-p to 2.5Vp-p	10mVp-p to 2.5Vp-p
Amplitude flatness (1Vp-p relative to 10 kHz):	≤10MHz	±0.1dB			
	≤100MHz	±0.2dB			
	≤160MHz	±0.6dB			
	≤240MHz	±1.0dB			
Harmonic distortion (1Vp-p)	≤10MHz	-65dBc			
	≤50MHz	-50dBc			
	≤80MHz	-40dBc			
	≤130MHz	-35dBc			
	≤240MHz	-28dBc			
Total harmonic distortion DC to 20kHz (typical):		0.05%			
Non-harmonic spuri:		-65dBc			
Phase noise (10MHz, 1Vp-p, 10kHz offset):		-113dBc/Hz			
SQUARE:					
Frequency range:		1μHz to 25MHz		1μHz to 100MHz	
Frequency resolution:		1μHz, 14 digits		1μHz, 15 digits	
Output level (into 50Ω) :	≤50MHz	10mVp-p to 10Vp-p		10mVp-p to 10Vp-p	
	≤ 100MHz			10mVp-p to 4Vp-p	
Duty cycle:		0.001% to 99.999%, 0.001% resolution			
Rise and fall times (typical) :	≤ 4Vp-p	10ns, fixed		3ns fixed	
	> 4Vp-p			5ns fixed	
Aberrations (typical) :		±5% of amplitude			
Jitter (RMS) :		<30ps (cycle to cycle)			
RAMP:					
Frequency range:		1μHz to 5MHz			
Frequency resolution:		1μHz, 13 digits			
Output level (into 50Ω) :		10mVp-p to 10Vp-p			
Linearity error:		<0.1% to 100kHz		<0.1% to 200kHz	
Variable symmetry:		0.00% to 100.00%, 0.01% resolution			

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MODEL:		TGF4042	TGF4082	TGF4162	TGF4242
PULSE:					
Frequency range:		1mHz to 25MHz		1mHz to 100MHz	
Frequency resolution:		1mHz, 11 digits		1mHz, 12 digits	
Output level (into 50Ω) :	≤50MHz	10mVp-p to 10Vp-p		10mVp-p to 10Vp-p	
	≤ 100MHz			10mVp-p to 4Vp-p	
Aberrations (typical) :		±5% of amplitude (for transition time 10ns) ±3% of amplitude (for transition time 20ns) <±2% of amplitude (for transition time >40ns)		±5% of amplitude (for transition time 5ns) ±3% of amplitude (for transition time 10ns) <±2% of amplitude (for transition time >20ns)	
Jitter (RMS) :		<30ps (cycle to cycle)			
Rise and fall times:	Range: ≤ 4Vp-p	8ns to 799.99999984s (10% to 90%)		3ns to 799.99999989s (10% to 90%)	
	Range: > 4Vp-p			5ns to 799.99999989s (10% to 90%)	
	Resolution:	100ps			
	Accuracy:	±500ps ±0.01% of period			
	Rise and Fall times can be independently varied or can be varied together simultaneously.				
Width:	Range: ≤ 4Vp-p	20ns to 999.99999998s		5ns to 999.99999995s	
	Range: > 4Vp-p			10ns to 999.99999990s	
	Resolution:	100ps			
	Accuracy:	±200ps ±0.01% of period			
Duty:		0.001% to 99.999%, 0.01% of period			
Delay:	Range:	0ns to 999.99999996s		0ns to 999.99999998s	
	Resolution:	100ps			
	Accuracy:	±200ps ±0.01% of period			
	Delay can be entered as absolute delay or phase.				
ARBITRARY:					
In built arbitrary waveforms (Sin(x)/x, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Cardiac, Gaussian, Lorentz and D-Lorentz). Up to 4 user-defined waveforms may be stored in non-volatile memory. Waveforms can be defined by downloading of waveform data via remote interfaces or from the instrument's front panel.					
Waveform memory size:		8192 points			
Vertical resolution:		14 bits		16 bits	
Frequency range:	In built:	1μHz to 2MHz		1μHz to 4MHz	
	User defined:	1μHz to 40MHz		1μHz to 80MHz	
Frequency resolution:	In built:	1μHz, 13 digits			
	User defined:	1μHz, 14 digits			
Output level (into 50Ω) :		10mVp-p to 10Vp-p			
Sampling rate:		400Msa/s		800Msa/s	
Point to point jitter (typical) :		2.5ns		1.25ns	
Rise and fall times:		<8ns		<5ns for 100MHz filter	
				<8ns for 62.5MHz filter	
Effective analog bandwidth (-3dB):		50MHz		62.5MHZ, 100MHz, user selectable	
NOISE:					
Gaussian White Noise: Noise can also be used as modulating waveform.					
Bandwidth (-3dB):		50MHz		100MHz	
Noise crest factor (Vp/Vrms):		6.4		5.16	
Output level (into 50Ω) :		10mVp-p to 10Vp-p			

UPCE 8 smlouvy 2374/25, 8 provedky 4447

MODEL:	TGF4042	TGF4082	TGF4162	TGF4242
PBRS: (ONLY AVAILABLE IN TGF4162 & TGF4242)				
Bit rate:	-		1μbps to 100Mbps, 1μbps resolution	
Sequence length:	-		2 ^M - where M = 7, 9, 11, 15, 20, 23, 29 or 31	
Rise and fall times (typical):	-		5ns fixed	
Output level (into 50Ω) :	-		10mVp-p to 10Vp-p	
HARMONIC OUTPUT: (ONLY AVAILABLE IN TGF4162 & TGF4242)				
Harmonic waveforms can be defined and stored in user-defined arbitrary waveform locations.				
Frequency Range:	-		1μHz to 80MHz	
Frequency Resolution:	-		1μHz, 14 digits	
Harmonic Order:	-		1 to 50, Up to 16 different harmonics order can be defined	
Harmonic Amplitude:	-		0.0% to 100.0% of output amplitude, 0.1% resolution	
Harmonic Phase:	-		-360.0 to +360.0 degrees, 0.1 degree resolution	
Output level (into 50Ω) :	-		10mVp-p to 10Vp-p	
INTERNAL FREQUENCY REFERENCE:				
Initial Setting Error:	<± 1ppm			
Oscillator Aging Rate:	<± 1ppm first year			
Temperature Stability:	<1ppm over the specified temperature range			
MODULATION:				
AM (AMPLITUDE MODULATION) NORMAL & SUPPRESSED CARRIER:				
Carrier Waveforms:	Sine, Square, Ramp, Pulse, Noise, Arb			
	-		PRBS	
Maximum Carrier Frequency:	25MHz, subject to carrier waveform.		50MHz, subject to carrier waveform.	
Modulation Source:	Internal/External			
Internal Modulating Waveforms:	Sine, Square, Positive Ramp, Negative Ramp, Triangle, Gaussian Noise, DC, Sinc, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Gaussian, Lorentz, D-Lorentz, Cardiac and User Defined Arbs			
	-		PRBS-PN7, PN9, PN11, PN15, PN20, PN23, PN29, PN31	
Internal Modulating Frequency:	1μHz to 10MHz, 1μHz resolution			
Amplitude Depth:	0.00% to 100.00%, 0.01% resolution			
FM (FREQUENCY MODULATION):				
Carrier Waveforms:	Sine, Square, Ramp, Arb			
Modulation Source:	Internal/External			
Internal Modulating Waveforms:	Sine, Square, Positive Ramp, Negative Ramp, Triangle, Gaussian Noise, DC, Sinc, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Gaussian, Lorentz, D-Lorentz, Cardiac and User Defined Arbs.			
	-		PRBS-PN7, PN9, PN11, PN15, PN20, PN23, PN29, PN31	
Internal Modulating Frequency:	1μHz to 10MHz, 1μHz resolution			
Frequency Deviation:	DC to Fmax/2, 1μHz resolution			
PM (PHASE MODULATION):				
Carrier Waveforms:	Sine, Square, Ramp, Arb			
Modulation Source:	Internal/External			
Internal Modulating Waveforms:	Sine, Square, Positive Ramp, Negative Ramp, Triangle, Gaussian Noise, DC, Sinc, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Gaussian, Lorentz, D-Lorentz, Cardiac and User Defined Arbs.			
	-		PRBS-PN7, PN9, PN11, PN15, PN20, PN23, PN29, PN31	
Internal Modulating Frequency:	1μHz to 10MHz, 1μHz resolution			
Phase Deviation:	-360.000 to +360.000 degrees, 0.001 degree resolution			

MODEL:	TGF4042	TGF4082	TGF4162	TGF4242
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ASK (AMPLITUDE SHIFT KEYING):

Carrier Waveforms:	Sine, Square, Ramp, Pulse, Noise, Arb		
	-	PBRs	
Maximum Carrier Frequency:	25MHz, subject to carrier waveform.		50MHz, subject to carrier waveform.
Source:	Internal/External (via TRIG IN)		
Internal Modulation:	2mHz to 10MHz (50% duty cycle square)		

FSK (FREQUENCY SHIFT KEYING):

Carrier Waveforms:	Sine, Square, Ramp, Arb		
Source:	Internal/External (via TRIG IN)		
Internal Modulation:	2mHz to 10MHz (50% duty cycle square)		

BPSK (BINARY PHASE SHIFT KEYING):

Carrier Waveforms:	Sine, Square, Ramp, Arb		
Modulation Source:	Internal/External (via TRIG IN)		
Internal Modulation:	2mHz to 10MHz (50% duty cycle square)		

PWM (PULSE WIDTH MODULATION):

Carrier Waveforms:	Pulse	
Modulation Source:	Internal/External	
Internal Modulating Waveforms:	Sine, Square, Positive Ramp, Negative Ramp, Triangle, Gaussian Noise, DC, Sinc, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Gaussian, Lorentz, D-Lorentz, Cardiac, and User Defined Arbs (PRBS waveforms only available in TGF4162 and TGF4242).	
	-	PRBS-PN7, PN9, PN11, PN15, PN20, PN23, PN29, PN31
Internal Modulating Frequency:	1μHz to 10MHz, 1μHz resolution	
Pulse Width Deviation:	0% to 100% of pulse width, 0.01% resolution	

SUM (ADDITIVE MODULATION): (ONLY AVAILABLE IN TGF4162 & TGF4242)

Carrier Waveforms:	-	Sine, Square, Ramp, Pulse, Noise, PRBS, Arb	
Maximum Carrier Frequency:	-	50MHz, subject to carrier waveform.	
Modulation Source:	-	Internal/External	
Internal Modulating Waveforms:	-	Sine, Square, Positive Ramp, Negative Ramp, Triangle, Gaussian Noise, DC, Sinc, Exponential Rise, Exponential Fall, Logarithmic Rise, Logarithmic Fall, Haversine, Gaussian, Lorentz, D-Lorentz, Cardiac, PRBS-PN7, PN9, PN11, PN15, PN20, PN23, PN29, PN31 and User Defined Arbs.	
Internal Modulating Frequency:	-	1μHz to 10MHz, 1μHz resolution	
Ratio:	-	0% to 100%, 0.01% resolution	

TRIGGERED BURST:

Each active edge of the trigger signal will produce one burst of the waveform.

Carrier Waveforms:		Sine, Square, Ramp, Pulse, Arb: A fixed number of cycles, specified as number of cycles are generated at every trigger event. Noise: Noise is reset to its start condition at every trigger event. Allows generating same random noise sequence.	
		-	PRBS: A fixed number of bits, specified as number of cycles are generated at every trigger event
Maximum Carrier Frequency:		25MHz (finite cycles), Fmax(infinite), subject to carrier waveform.	50MHz (finite cycles), Fmax(infinite), subject to carrier waveform.
Number of Cycles:		1 to 2147483647 and infinite	
Trigger Repetition Rate:	Internal	2mHz to 25MHz	2mHz to 50MHz
	External	DC to 1MHz	
Trigger Signal Source:	Internal	From keyboard or trigger generator.	
	External	From TRIG IN or remote interface.	
Trigger Start/Stop Phase:		-360.000 to +360.000 degrees, 0.001 degree resolution. Phase offset cannot be set for Noise and PRBS waveforms	

MODEL:		TGF4042	TGF4082	TGF4162	TGF4242
GATED:					
Waveform will run while the Gate signal is true and stop while false.					
Carrier Waveforms:		Sine, Square, Ramp, Pulse, Noise, Arb			
		-		PRBS	
Maximum Carrier Frequency:		25MHz, subject to carrier waveform.		50MHz, subject to carrier waveform.	
Trigger Repetition Rate:	Internal	2mHz to 25MHz		2mHz to 50MHz	
	External	DC to 1MHz			
Gate Signal Source:	Internal	From keyboard or trigger generator.			
	External.	From TRIG IN or remote interface			
Gate Start/Stop Phase:		-360.000 to +360.000 degrees, 0.001 degree resolution. Phase offset cannot be set for Noise and PRBS waveforms.			
SWEEP:					
Frequency sweep capability is provided for both standard and arbitrary waveforms.					
Carrier Waveforms:		Sine, Square, Ramp, Arb			
Sweep Mode:		Linear or logarithmic, triggered or continuous.			
Sweep Direction:		Up or Down			
Sweep Range:		From 1μHz to Fmax. Phase continuous. Independent setting of the start and stop frequency.			
Sweep Time:		1μs to 500s (9 digit resolution).			
Sweep Trigger Source:		The sweep may be free run or triggered from the following sources: Internal from keyboard or trigger generator. Externally from TRIG IN input or remote interface. External trigger repetition rate: DC to 1MHz			
TRIGGER GENERATOR:					
Internal Source Rate or Frequency		40ns to 500s or 2mHz to 25MHz square waves adjustable in 10ns steps.		20ns to 500s or 2mHz to 50MHz square waves adjustable in 10ns steps.	
Resolution		10ns, 11 digits			
Each channel has its own trigger generator. Channel 1 trigger is available for external use from the MAIN OUT 2 socket when Channel 2 is configured to output Channel 1 sync waveform and sync source is set to trigger.					
DUAL-CHANNEL OPERATIONS:					
TRACKING:					
Independent (Off):		The channels are independent of each other.			
Equal:		The two channels are identical and behave identically.			
COUPLING:					
Frequency coupling:		The frequencies of the two channels can be coupled. Changing the frequency of one channel changes the frequencies of both channels.			
Amplitude (and DC Offset) coupling:		Amplitude (and DC offset) of the two channels can be coupled. Changing the amplitude and offset on one channel changes the amplitude and offset of both channels.			
Output coupling:		Output On/Off can be coupled. Switching the output On/Off on one channel switches the output On/Off of both channels.			
CHARACTERISTICS:					
Relative phase:		-360.000 to 360.000 degrees, 0.001 degree resolution (Phase offset cannot be set for Noise)			
Channel to channel Skew (typical):		<1ns (when performing identical operations)			
Crosstalk (typical):		<-80db			

MODEL:	TGF4042	TGF4082	TGF4162	TGF4242
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EXTERNAL FREQUENCY MEASUREMENT:

Function:		Frequency, Period, Positive Width, Negative Width, Duty Cycle
Frequency Range:	AC coupled	3Hz to >125MHz
	DC coupled	100mHz to >125MHz
Source:	AC coupled	REF / COUNT (AC) IN
	DC coupled	TRIG / COUNT (DC) IN
Frequency Resolution:		Up to 7 digits displayed.
Measurement Time:		Automatic
Input Range and Sensitivity:	AC coupled	≤50MHz- 100mVpp- 5Vpp >50MHz- 250mVpp- 5Vpp Maximum input ±10V
	DC coupled	Threshold typically 1.2V; Sensitivity 100mVpp (≤50MHz), 250mVpp (<50MHz) Maximum input +5V,-1V
Hysteresis:	Input hysteresis voltage	10mV
Accuracy:		±1 digit ± timebase accuracy.
Timebase Accuracy:		<± 1ppm initial settling error, <± 1ppm oscillator aging rate in the first year, <1ppm over the specified temperature range

OUTPUTS:

MAIN OUTPUTS:

Output impedance:	50Ω				
Amplitude (sine):		20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω			
	≤50MHz		20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω		
	≤80MHz		20mVp-p to 10Vp-p open circuit, 10mVp-p to 5Vp-p into 50Ω	20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω	20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω
	≤120MHz			20mVp-p to 10Vp-p open circuit, 10mVp-p to 5Vp-p into 50Ω	20mVp-p to 10Vp-p open circuit, 10mVp-p to 5Vp-p into 50Ω
	≤240MHz			20mVp-p to 5Vp-p open circuit, 10mVp-p to 2.5Vp-p into 50Ω	20mVp-p to 5Vp-p open circuit, 10mVp-p to 2.5Vp-p into 50Ω
Amplitude (Pulse):		20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω			
	≤50MHz			20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω	20mVp-p to 20Vp-p open circuit, 10mVp-p to 10Vp-p into 50Ω
	≤100MHz			20mVp-p to 8Vp-p open circuit, 10mVp-p to 4Vp-p into 50Ω	20mVp-p to 8Vp-p open circuit, 10mVp-p to 4Vp-p into 50Ω

Amplitude can be specified open circuit (hi Z) or into an assumed load of 1Ω to 10kΩ in Vpp.

Amplitude Accuracy:	1.5% ±5mV at 1kHz into 50Ω
DC Offset Range:	±10V. DC offset plus signal peak limited to ±10V from 50Ω.
DC Offset Accuracy:	Typically 1% ±50mV.
Resolution:	3 digits or 1mV for both Amplitude and DC Offset.

MODEL:		TGF4042	TGF4082	TGF4162	TGF4242
SYNC OUTPUT:					
Channel 2 can be configured to output Channel 1 sync from its MAIN OUT 2 socket. Sync is a multi function output which is automatically selected to be any of the following. Alternatively, the user can choose Sync to always be carrier referenced, to output the currently used trigger signal or turn it off.					
Carrier Waveform Sync:	Sine Square Ramp Pulse Arbs	$\leq 28.125\text{MHz}$ - A square wave with 50% duty cycle at the waveform frequency. $\leq 80\text{MHz}$ - A sine wave at the waveform frequency.		$\leq 62.5\text{MHz}$ - A square wave with 50% duty cycle at the waveform frequency. $\leq 240\text{MHz}$ - A sine wave at the waveform frequency.	
	Pattern	A positive pulse which is 1 bit rate wide at the beginning of the sequence			
	Noise	No sync associated with noise.			
Modualtion sync:	AM/FM/ PM/SUM/ PWM	A square wave with 50% duty cycle referenced to the internal modulation waveform when modulation source is internal, or a square wave referenced to the carrier waveform when modulation source is external. No sync is associated with Noise and DC waveforms as the modulation source .			
	ASK	A square wave referenced to the trigger rate. The sync is a TTL high when hop amplitude is the output amplitude and TTL low when carrier amplitude is the output amplitude for positive slope and vice versa for negative slope.			
	FSK	A square wave referenced to the trigger rate. The sync is a TTL high when hop frequency is the output frequency and TTL low when carrier frequency is the output frequency for positive slope and vice versa for negative slope.			
	BPSK	A square wave referenced to the trigger rate. The sync is a TTL high when the hop phase is the output phase and TTL low when carrier phase is the output phase for positive slope and vice versa for negative slope.			
Sweep Sync:		A square wave that is a TTL high from the beginning of the sweep and a TTL low from the midpoint of the sweep			
Burst Sync:	Internal Trigger	A square wave with 50% duty cycle at the trigger frequency.			
	External Trigger	A square wave with same duty cycle and frequency as the external source.			
	Manual Trigger	A positive pulse which is approximately 18us wide at the beginning of the event.			
Trigger:		Selects the current trigger signal.			
Output Signal Level:		Logic level nominally 3V			
Output Impedance:		50 Ω			
REF CLOCK OUTPUT:					
Buffered version of the 10MHz clock currently in use (internal or external)					
Output Level:		Nominally 3V logic level from 50 Ω			
INPUTS:					
TRIGGER / COUNT (DC) INPUT:					
For ASK, FSK, BPSK, triggered sweep, gated burst, triggered burst and DC coupled external frequency measurement.					
Frequency Range:	Trigger Input	DC – 1MHz			
	Counter Input	100mHz to >125MHz			
Signal Range:		Threshold typically 1.2V; Sensitivity 100mVpp ($\leq 50\text{MHz}$), 250mVpp (>50MHz) Maximum input +5V /-1V.			
Minimum Pulse Width (Trigger Input):		50ns			
Polarity (Trigger Inpput):		Selectable as high/rising edge or low/falling edge.			
Input Impedance:		10k Ω			
EXTERNAL MODULATION INPUT:					
For AM, FM, PM, SUM and PWM					
Voltage Range:		$\pm 2.5\text{V}$ full scale			
Input Impedance:		5k Ω typical			
Bandwidth:		DC to 5MHz			

MODEL:	TGF4042	TGF4082	TGF4162	TGF4242
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REF CLOCK / COUNT (AC) INPUT:

Input for an external 10MHz reference clock and AC coupled external frequency measurement.

Voltage Range:	≤50MHz - 100mVpp – 5Vpp >50MHz - 250mVpp – 5Vpp
Maximum Voltage:	+10V
Minimum Voltage:	-10V

INTERFACES:

Full digital remote control facilities are available through LAN, USB and optional GPIB interfaces.

LAN Interface	Ethernet 100/10base – T hardware connection. 1.5 LXI Device Specification 2016
USB Interface	Standard USB 2.0 hardware connection. Implemented as virtual-COM port.
USB Flash Drive	For waveform and set-up storage/recall.
GPIB (optional)	Conforming with IEEE488.1 and IEEE488.2

GENERAL:

Display:	4.3 inch (10.9 cm) transfective backlit TFT LCD, 480 x 272 pixels, 262144 colours, adjustable brightness and contrast.
Data Entry:	Keyboard selection of mode, waveform etc.; value entry direct by numeric keys or by rotary control.
Stored Settings:	Up to 9 complete instrument set-ups may be stored and recalled from internal memory.
Size:	Bench Top: 97mm height; 250mm width; 295mm depth
	Rack mount: 86.5mm (2U) height; 213.5mm (½"rack) width; 269mm depth
Weight:	3.1kg
Power:	100-240VAC ±10% 50/60Hz; 100-120VAC ±10% 400Hz; 60VA max. Installation Category II.
Operating Range:	+5°C to 40°C, 20-80% RH.
Storage Range:	-20°C to + 60°C.
Environmental:	Indoor use at altitudes up to 2000m, Pollution Degree 2.
Options:	19 inch rack mounting kit.
Safety & EMC:	Complies with EN61010-1 & EN61326-1.

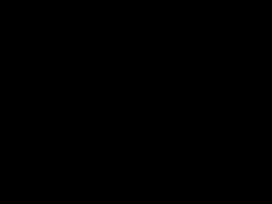
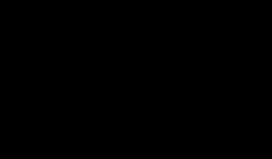
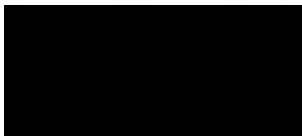
For details, request the EU Declaration of Conformity for this instrument via <http://www.aimtti.com/support> (serial no. needed).

General specifications apply for the temperature range 5°C to 40°C.

Accuracy specifications apply for the temperature range 18°C to 28°C after 30 minutes warm-up, at maximum output into 50Ω.

Typical specifications are determined by design and are not guaranteed.

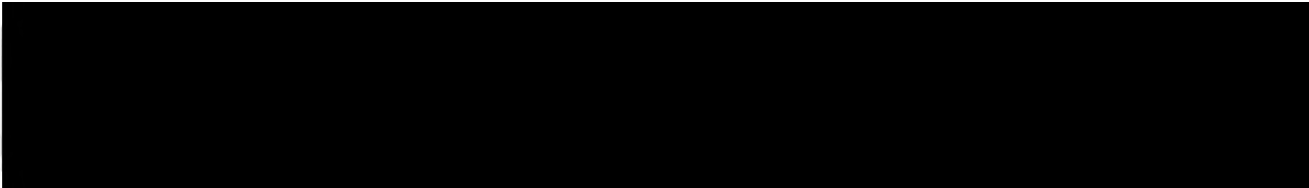
WAVEFORM GENERATOR RANGE

			
TG300 SERIES 3MHz FUNCTION ANALOG 1 CHANNEL	TG1006 10MHz FUNCTION DDS 1 CHANNEL	TG1000 & 2000 SERIES 10MHz / 20MHz FUNCTION DDS 1 CHANNEL USB & RS232	TGXX11/12A 25MHz / 50MHz FUNCTION / PULSE / ARB DDS - 125MS/s FIXED 1 & 2 CHANNEL USB, LAN & GPIB*
			
80MHz/160MHz FUNCTION/ PULSE/ ARB DDS - 800MS/s FIXED 2 CHANNEL USB, LAN & GPIB*	10MHz PULSE ANALOG 1 CHANNEL	25MHz / 50MHz PULSE/ FUNCTION/ ARB DDS - 800MS/s FIXED 1 & 2 CHANNEL USB, LAN & GPIB	16MHz TRUE ARB - 40MS/s MAX. DDS - 40MS/s FIXED 1, 2 & 4 CHANNEL RS232 & GPIB
	COMING SOON		
TGA12100 SERIES 40MHz TRUE ARB - 100MS/s MAX. DDS - 100MS/s FIXED 1, 2 & 4 CHANNEL USB, RS232 & GPIB	TGA12200 SERIES 80MHz TRUE ARB - 200MS/s MAX. DDS - 500MS/s FIXED 2 & 4 CHANNEL USB, LAN & GPIB*		

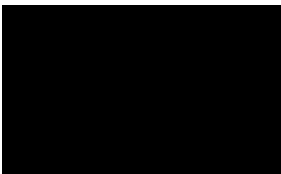
* GPIB OPTIONAL

OTHER RANGES AVAILABLE

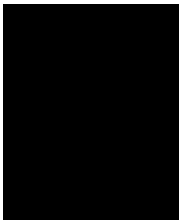
POWER SUPPLIES & LOADS



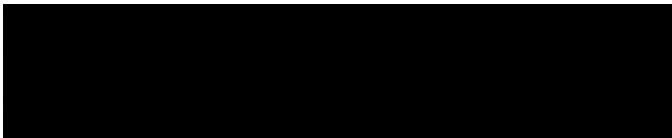
- ▶ 30w to 1200w Single and Multi channel PSUs for bench-top or remote control and system use.
- ▶ Flexible electronic DC loads for general purpose applications.



SIGNAL
GENERATORS



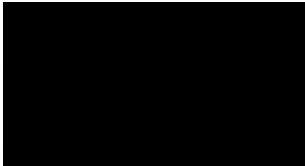
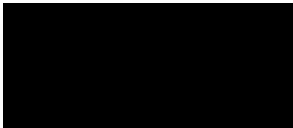
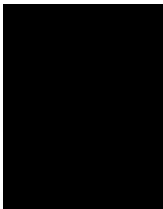
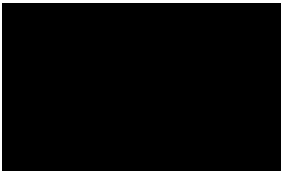
SPECTRUM
ANALYSERS



HARMONICS
ANALYSERS

LOW-DISTORTION
SOURCE

- ▶ RF signal generators with frequency capability up to 6GHz.
- ▶ Handheld RF spectrum analyzers with frequency up to 6GHz.
- ▶ EMC analyzers for power Harmonics and Flicker.



- ▶ Bench-top digital multimeters for dual display, system and logging.
- ▶ Innovative DC to 5MHz current probes for PCB tracks.
- ▶ Handheld and bench-top frequency counters up to 6GHz.
- ▶ Precision component measurements.

EXCELLENCE THROUGH EXPERIENCE

Aim-TTi is the trading name of Thurlby Thandar Instruments Ltd. (TTi), one of Europe's leading manufacturers of test and measurement instruments. The company has wide experience in the design and manufacture of advanced test instruments and power supplies built up over more than thirty years. The company is based in the United Kingdom, and all products are built at the main facility in Huntingdon, close to the famous university city of Cambridge.

TRACEABLE QUALITY SYSTEMS

TTi is an ISO9001 registered company operating fully traceable quality systems for all processes from design through to final calibration.



ISO9001:2015

Certificate number FM 20695

WHERE TO BUY AIM-TTI PRODUCTS

Aim-TTi products are widely available from a network of distributors and agents in more than sixty countries across the world.

To find your local distributor, please visit our website which provides full contact details.

www.aimtti.com

www.aimtti.us



Precision ECR Meter

FEATURES

- 3.5" Color LCD
- 5 Models (10 Hz to 2 kHz/20 kHz/100 kHz/200 kHz/300 kHz)
- Consecutive Test Frequency
- Basic Accuracy : 0.05 %
- Measuring Speed up to 25 ms (Max.)
- Full Frequency Range or Spot OPEN/SHORT
- 16 Major/Secondary Parameter Measurement Combinations and Two Additional Monitoring Parameters (Maximum Four Different Parameters Can be Shown Simultaneously)
- DCR Measurement and Internal D.C. Bias Voltage (± 2.5 V)
- PASS/FAIL Judgment
- Auto Level Control (ALC) Function
- BIN Function Provides 9 BIN and 1 AUX, Totally 10 BIN
- 10 Steps Listed Tests to Select Different Frequency, Voltage and Current Criteria
- Standard Interface : RS-232C, Handler and USB Host/Device
- Compact Size, Ideal for Automatic Equipment (2 U, 1/2 Rack)

GW Instek introduces the brand new high precision LCR meter - LCR-6000 series, which, with five models, has a test frequency range extending from 2 kHz/20 kHz/100 kHz/200 kHz/300 kHz (maximum) and with 0.05 % basic accuracy. The compact size design, 2 U height and 1/2 rack, is one of the practical features of the series which is the optimum space saver suitable for either bench top or system rack. The compacted LCR-6000 series with abundant features is absolutely the excellent tool for R&D, production test, IQC, etc. on implementing each test stages for passive components.

The LCR-6000 series provides rich functionalities with the compact size. First of all, the entire series adopts 3.5-inch color LCD and features opulent display parameters. In addition to simultaneously displaying setting criteria and measurement results, the series increases two additional monitoring parameters. In other words, there are four parameters, primary/secondary and two monitoring, simultaneously shown on the screen that tremendously enhances the measurement efficiency. The enlarge display mode not only emphasizes the measurement results, but also provides PASS/FAIL judgment to facilitate a rapid and convenient test result.

Convenience is one of the unique features. The LCR-6000 series comes equipped with two zero methods, which are full frequency range and spot. Users, without turning off the power and changing test fixture, can freely change frequency within the provided frequency range to conduct measurements. By so doing, tremendous time can be saved from repeatedly executing zero operation. Additionally, frequency range of the series is consecutive that allows users to input precise frequency value to conduct the most genuine test on components.

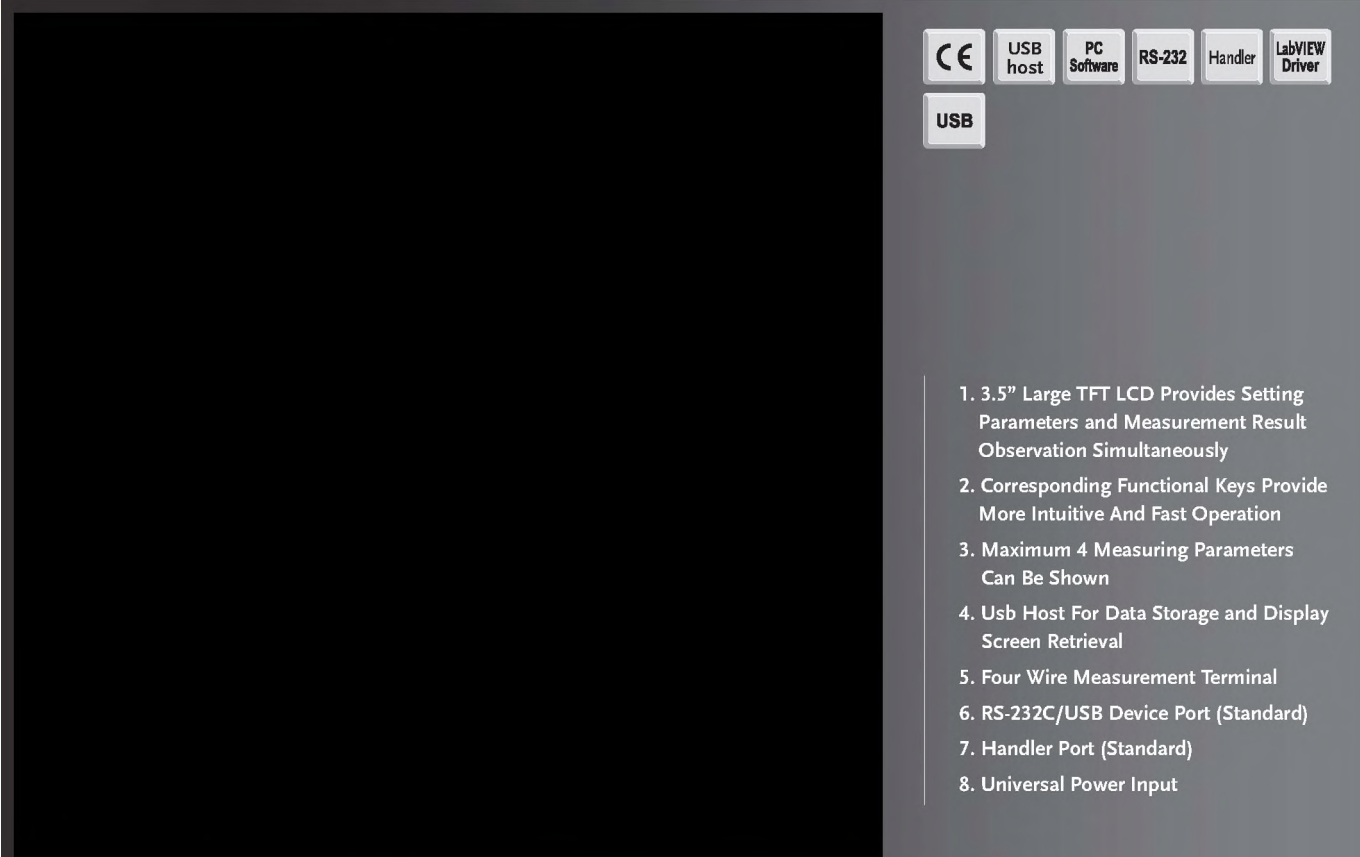
The LCR-6000 series also features diverse ancillary measurements to meet the measurement requirements of different materials. For instance, the series provides the automatic level control (ALC) function to satisfy the test voltage requirement of MLCC. For inductive component measurements, the series provides the adjustable test current function and the D.C. resistance measurement function. The optional external bias current adapter (± 2.5 A) is to satisfy the measurement requirements. With respect to the D.C. bias voltage test for capacitive components requirements, the series allows users to conduct verification measurement on materials by its internal ± 2.5 V adjustable voltage or via an optional external bias voltage adapter (± 45 V). Furthermore, 10 steps of listed test functionalities allow users to set testing parameters (either by frequency, or voltage, or current) for each step based on users' requirements in order to observe the trend of DUT characteristics.

The LCR-6000 series has 10 memory sets defined by panel setting criteria to facilitate users in selecting test criteria and saving time in repeated settings. 10,000 measurement result storage capability can easily record measurement results instantaneously. The USB host allows easy access to recorded results without connecting the series to the PC. The USB host also allows USB to retrieve and save screen so as to assist users in compiling setting guidelines.

For the external control, the LCR-6000 series provides handler interface and collocates with its measurement sorting function (9BIN, AUX: 1BIN) to facilitate the connection with sorting machine so as to sort out the materials. For remote control and measurement result retrieval requirements, the LCR-6000 series provides RS-232C to assist setting control or measurement result retrieval via the PC commands. Additionally, the free PC software gives users an instant tool to store measurement results that saves time in developing programs.

The brand new compacted LCR-6000 series can effectively improve the limitation of space. Diverse measurement functionalities and display methods are making the series the high CP ratio choice in meeting the requirements of R&D, component assessment for engineering departments, category sorting requirements for component production, and IQC for verification on component specifications.

PANEL INTRODUCTION



1. 3.5" Large TFT LCD Provides Setting Parameters and Measurement Result Observation Simultaneously
2. Corresponding Functional Keys Provide More Intuitive And Fast Operation
3. Maximum 4 Measuring Parameters Can Be Shown
4. Usb Host For Data Storage and Display Screen Retrieval
5. Four Wire Measurement Terminal
6. RS-232C/USB Device Port (Standard)
7. Handler Port (Standard)
8. Universal Power Input

A. Consecutive Frequency and Convenient Zero Function

B. Rich and Diverse Information Display



Consecutive and Adjustable Frequency
Freely Input Frequency Within Provided Frequency Range

Selectable Fixture Zeroing Methods
Full Frequency Range Zero or Spot Zero

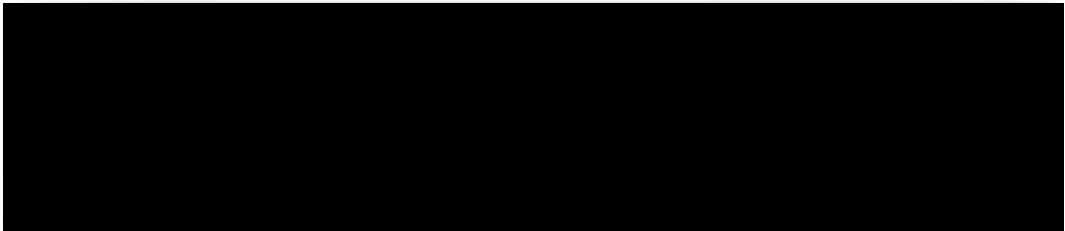
The LCR-6000 series, within the provided frequency range, features consecutive and adjustable frequency capability which allows users to conduct measurement and analysis on components with the most genuine frequency requirements. For OPEN/SHORT fixture compensation function, the LCR-6000 series is equipped with full frequency range zero and spot zero selections. After executing full frequency range zero, users, under the conditions of not turning off the power and not changing test fixture, can freely change test frequency for the LCR-6000 series to execute component measurements that tremendously saves time in repeatedly zeroing test fixture after changing frequency.

MEAS Display
Parameter Setting and Four Measurement Parameters

ENLARGE Display
Enlarge Measurement Results and Include PASS/FAIL Judgment

The measurement result display of the LCR-6000 series not only reveals major and secondary measurement parameters but also includes two monitoring parameters. Therefore, four DUT related parameters can be simultaneously shown on the display screen to save time if repeated measurements are required. With respect to display screen, the LCR-6000 series features diverse display to meet users' observation requirements. For instance, MEAS display shows setting parameters and measurement results at the same time; ENLARGE display focuses on measurement results and PASS/FAIL judgment is available, which is conducive to assist engineers to swiftly obtain the validity of measurement results.

C. Diverse Ancillary Measurement Functions



Automatic Level Control
Ideal for Measuring Components With Voltage Requirements

Internal Bias (± 2.5 V Adjustable)
Ideal for Capacitive Components' Characteristic Tests

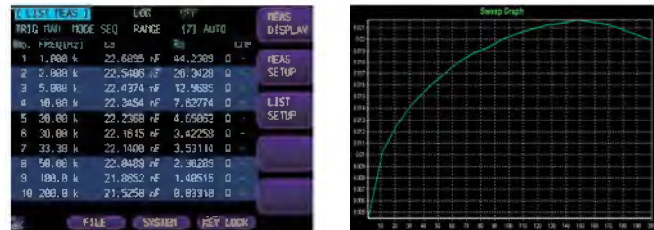
D.C. Resistance Measurement
Ideal for inductive components' D.C. Characteristics Verification

To satisfy the diverse measurement application requirements for different components and materials, the LCR-6000 series collocates with many auxiliary measurement functions. For capacitor measurement, Automatic Level Control (ALC) is mainly for component which requires a constant or rated test voltage such as multi-layer ceramic capacitor (MLCC). An internal D.C. bias voltage (± 2.5 V, internal) is allowing simulating A.C. and D.C.

coexistence to learn capacitance variation. For inductor measurement, the D.C. resistance measurement function is to validate D.C. resistance characteristics. Additional, the LCZ function is to quickly identify components' characteristics. When the function is activated, the LCR-6000 series will automatically determine DUTs' characteristics and reveal the optimum parameters to show the measurement results.

D. 10 Points Listed Tests and PC Software

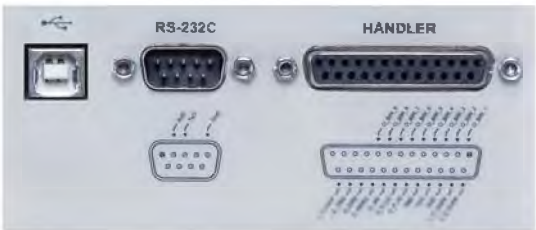
E. Standard Interface



Listed Tests
Variation Criteria Based Upon Frequency or Voltage/Current

On Software - Characteristic Curve
Provide More Delicate Characteristic Variation Trend

The LCR-6000 series provides the 10 points listed test function, which allows users to define a set of DUT measurement parameters (such as Cs-Rs) and to set 10 test criteria of category (either by frequency or by voltage or by current) but different values to conduct measurements. Through this function, users can rapidly and clearly obtain DUT's characteristic variation trend to determine the adaptability of DUT's practical applications. The measurement results can be recorded directly in the internal memory and be transferred to the PC through USB. The LCR-6000 series also provides free PC software (maximum 1,000 points listed tests) in order to satisfy users' analytical requirements on delicate variation.



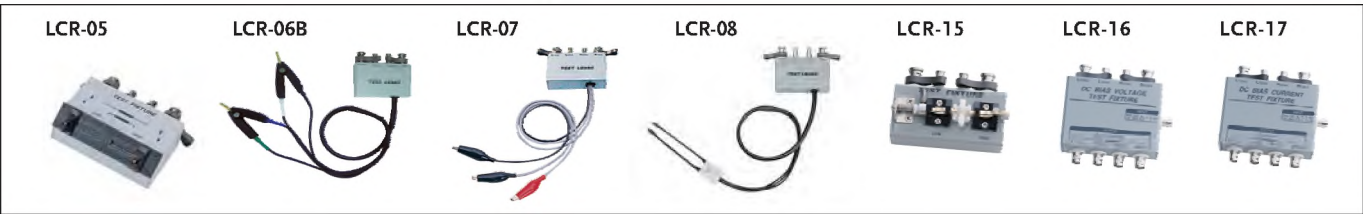
Standard Interface

For interface connectivity, the LCR-6000 series comes equipped with Handler interface and RS-232C/USB Device interface. Handler outputs 10 BIN (9BIN, AUX: 1BIN) sorting results that is best for external connection control, for instance, connecting to a sorting machine to conduct components' sorting operation. RS-232C/USB Device is suitable for remote control and measurement results retrieval. The PC gives commands to control settings or to read measurement results so as to achieve the requirements of verifying automotive applications.

SPECIFICATIONS		
TEST FREQUENCY		LCR-6300 : 10 Hz to 300 kHz (±0.01 %) (4 digits resolution) LCR-6200 : 10 Hz to 200 kHz (±0.01 %) (4 digits resolution) LCR-6100 : 10 Hz to 100 kHz (±0.01 %) (4 digits resolution) LCR-6020 : 10 Hz to 20 kHz (±0.01 %) (4 digits resolution) LCR-6002 : 10 Hz to 2 kHz (±0.01 %) (4 digits resolution)
OUTPUT IMPEDANCE		30 Ω / 50 Ω / 100 Ω selectable
BASIC ACCURACY	Slow / Med Fast	0.05 % 0.1 %
TEST SPEED		FAST : 25 ms / MED : 100 ms / SLOW : 333 ms
TEST SIGNAL LEVELS	AC Voltage Current DCR	10.00 mV to 2.00 V (±10 %) CV : 10.00 mV to 2.00 V (±6 %) 100.0 μA to 20.00 mA (±10%) CC : 100.0 μA to 20.00 mA (±6 %) (@2 VMax) +2V, 0.066 A (Max.), Output impedance fixed 30 Ω
DC BIAS	Internal	±2.5 V (0.5 % + 0.005 V)
DISPLAY RANGE	R, X, Z G, B, Y L C D Q θ d θ r DCR Δ%	0.00001 Ω to 99.9999 MΩ 0.01 nS to 999.999 S 0.00001 μH to 9999.99 H 0.00001 pF to 9999.99 mF 0.00001 to 9.99999 0.00001 to 99999.9 -179.999° to 179.999° -3.14159 to 3.14159 0.00001 Ω to 99.9999 MΩ -99999 % to 99999 %
TEST MODE	Combinations Monitor Parameter (2 Selectable)	Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, Rs-Q, Rp-Q, R-X, DCR, Z-θ r, Z-θ d, Z-D, Z-Q, Auto LCZ Z, D, Q, Vac, Iac, Δ, Δ%, θ r, θ d, R, X, G, B, Y
LISTED MODE		10 steps
BIN FUNCTION		Comparator (9 BIN, AUX: 1 BIN)
MEMORY	INT – Panel Setting INT – Measured Data USB Storage	10 file name 10000 Data (.csv) 10 file name for setting, 9999 file name for data, 999 Log file for LCD screen
OTHER FUNCTION	Auto Level Control (ALC) Average Trigger Delay Judgment Screen Capture	ON/OFF 1 to 256 times INT / MAN / EXT / BUS 0 ms to 60 s PASS / FAIL Saving in to USB (Bmp form)
DISPLAY		3.5" LCD, RGB color (320 x 240)
INTERFACE		RS-232 (SCPI), Handler, USB Host/Device
POWER SOURCE		AC 100 V to 240 V, 50 to 60 Hz, Max. 15 W
DIMENSIONS & WEIGHT		265 (W) mm x 107 (H) mm x 312 (D) mm ; Approx. 3 kg

Specifications subject to change without notice. CR-6000GD1BH 202502

ORDERING INFORMATION		OPTION	
LCR-6300	10 Hz to 300 kHz Precision LCR Meter	LCR-16	±45 V DC Bias Voltage Box
LCR-6200	10 Hz to 200 kHz Precision LCR Meter	LCR-17	±2.5 A DC Bias Current Box
LCR-6100	10 Hz to 100 kHz Precision LCR Meter	LCR-DB1	±200 V DC Bias Voltage Box (Freq. up to 2 MHz)
LCR-6020	10 Hz to 20 kHz Precision LCR Meter	OPTIONAL ASSESSORIES	
LCR-6002	10 Hz to 2 kHz Precision LCR Meter	LCR-05	Test Fixture for Axial & Radial Lead Components
ACCESSORIES		LCR-06B	Kelvin Clip Test Lead
Safety Sheet x 1, Power Cord x 1, Test Fixture LCR-06B x 1		LCR-07	Test Fixture, Two-Wire with Alligator Clips
		LCR-08	Test Fixture (Tweezers) for SMD/Chip Components
		LCR-15	Test Fixture for SMD/Chip Components (0201 to 1812)
		GTL-232	RS-232C Cable, 9-pin Female to 9-pin, null Modem for Computer, Approx. 2 m
		FREE DOWNLOAD	
		PC Software	LCR-6000 Series
		Driver	LabVIEW Driver
		GTL-246	USB Cable, USB 2.0 A-B TYPE CABLE, 4 P
		CRA-422	Rack Mount Kit, 19" 2 U size
		CRA-454	Rack Mount Kit, 19" 2 U size for one or two sets

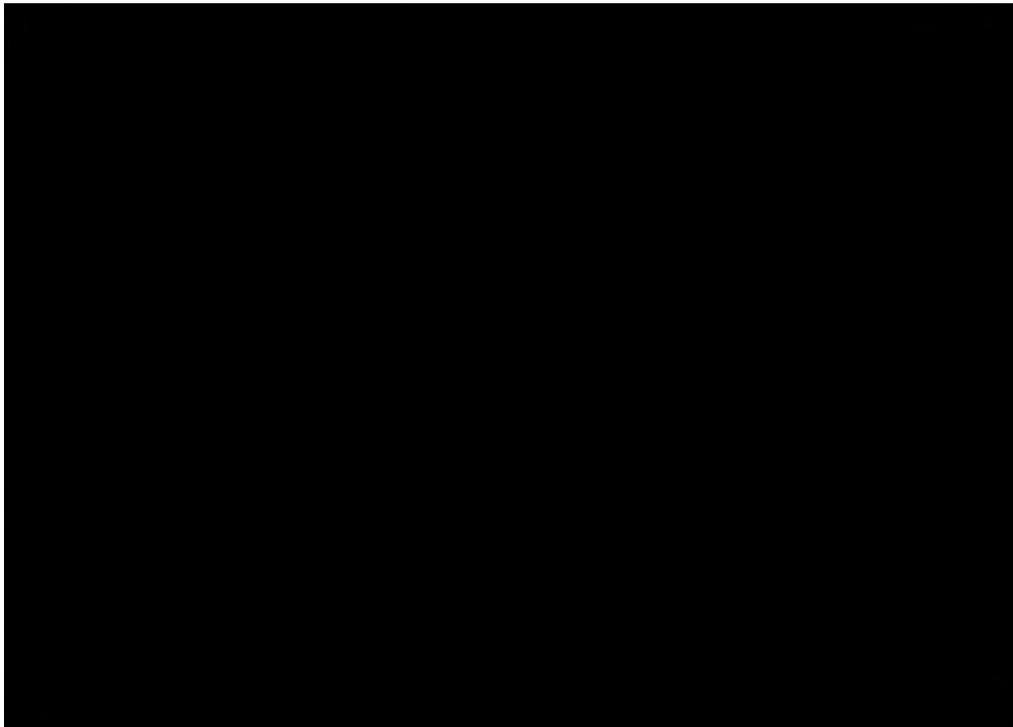


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EDU34450A 5½-Digit Dual-Display Digital Multimeter



Key features

- Measures 11 input signals:
 - DC voltage, DC current, true RMS AC voltage, AC Current, two- and four-wire resistance, frequency, continuity, diode test, temperature, and capacitance
- Signature 7-inch dual-measurement color display
- Fast reading rate of up to 110 readings/s for speed-critical measurements
- 5,000 points logging memory for recording more data and perform analysis
- Standard USB and LAN for flexible PC connectivity
- USB flash drive support to copy / load configuration for repeated test setup
- Includes PathWave BenchVue DMM software for remote control and data logging

EDU34450A Provides Industry-Grade Measurement Capabilities

The Keysight EDU34450A is a modern digital multimeter (DMM) designed for bench applications. It measures a broad range of input signals. It features 5½ digits of resolution and up to 110 readings/s measuring rate for speed-critical tests. It includes generous internal memory, allowing prolonged data logging of up to 5,000 data points.

With the EDU34450A, you get the benefits of Keysight measurement performance in a low-cost, compact package.

Combination of hard and soft keys for more intuitive front-panel operation

For easy access to the most frequently used measurement functions, the EDU34450A retains all the function keys found on a traditional DMM. The function key lights up when pressed to provide a clear indication of the parameter you are measuring. The intuitive soft keys allow more advanced configuration when the need arises. Combining these hard and soft keys allows you to quickly set up and begin your measuring tasks without a steep learning curve.

Standard connectivity to the PC

The DMM has built-in gigabit LAN and USB. The remote connectivity allows you to connect to the PathWave BenchVue DMM software for more advanced data logging and export logged data. You can also use the software to retrieve the data saved in the non-volatile memory. Software drivers are available if you prefer to write your own program, with SCPI commands to control the DMM and automate your test.

Signature 7-inch dual-measurement color display

The EDU34450A comes with a 7-inch, dual-measurement color display. With this innovation, you can view your measurement setup, instrument status, reading, and statistics all at once, without flipping through several screens.

It features a secondary display where you can view primary and secondary components of your input signal at the same time to help you better understand your device under test.

With the large display, you can set up data logging and view the logged data easily.

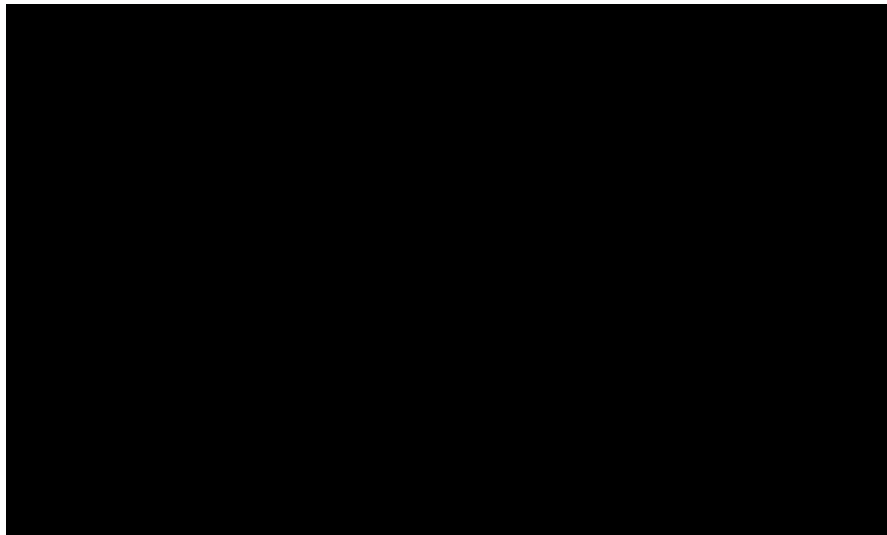
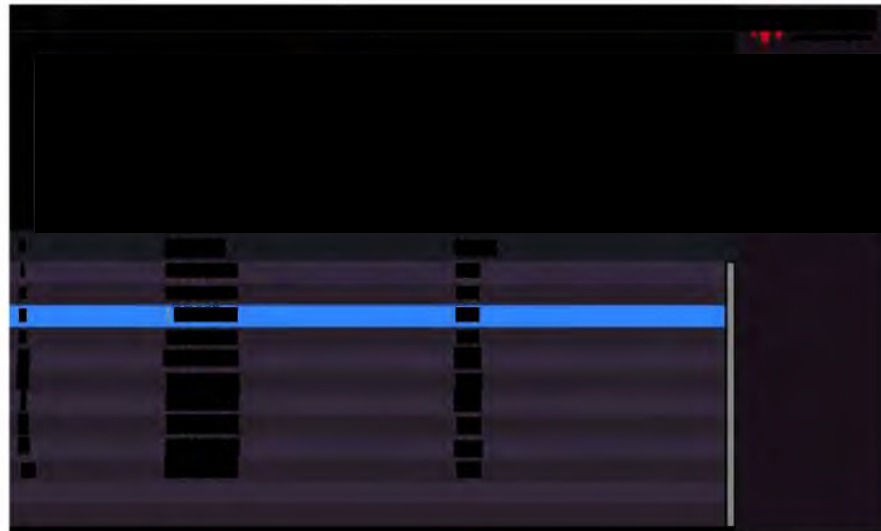
USB flash drive adds convenience

The EDU34450A also features a built-in USB memory port, so you can use a USB flash drive to store your DMM setup. This feature will help you install the same setup in all the DMMs in your lab.

Robust design

We know you can't afford instrument downtime caused by hardware failures and unscheduled maintenance. That's why our engineers designed reliability into the EDU34450A: a rugged enclosure; state-of-the-art, surface-mount construction throughout; reduced part counts; and rigorous and thorough

████████████████████



Simplify Data Gathering and Analysis with PathWave BenchVue DMM Software

PathWave BenchVue software for the PC makes it simple to connect, control, capture, and view Keysight DMMs with no additional programming.

- Easily log data, screenshots, and system state. Rapidly prototype custom test sequences.
- Recall the past state of your bench to replicate results.
- Quickly export measurement data in the desired format.
- Quickly access manuals, drivers, FAQs, and videos.

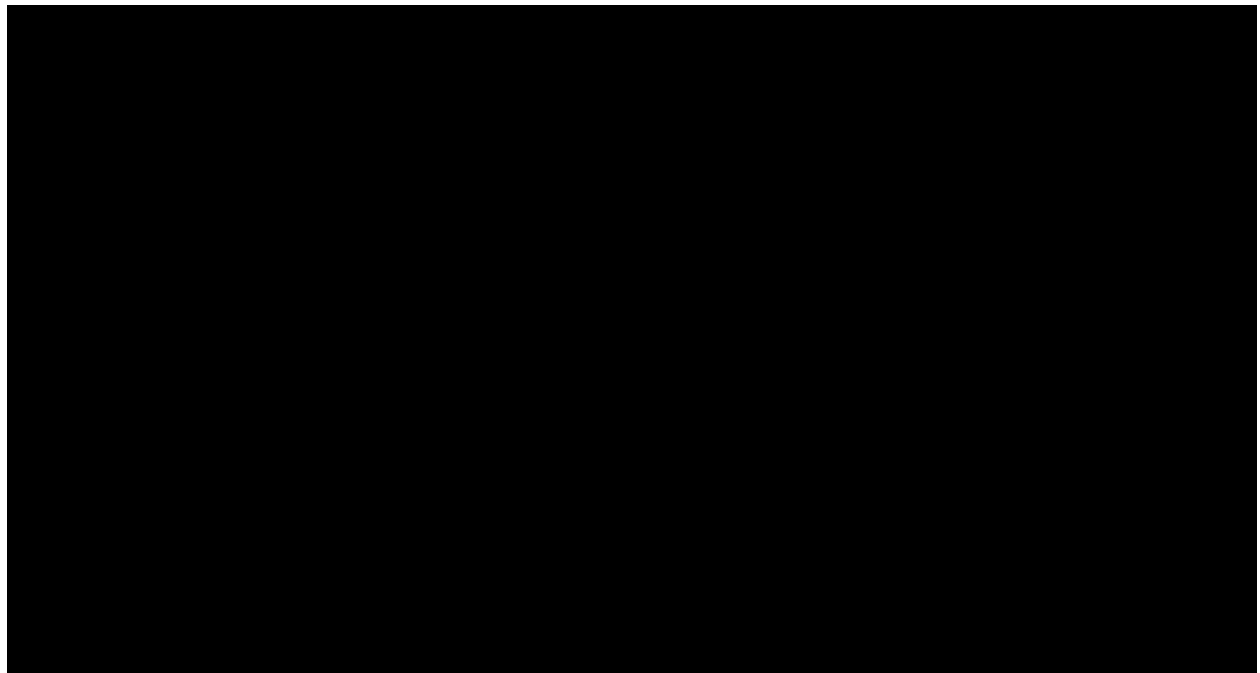
The DMM app in BenchVue allows you to control DMMs to visualize measurements and perform unrestricted data logging and statistical analysis. The software comes with your EDU34450A purchase.

Record measurements and export results in a few clicks

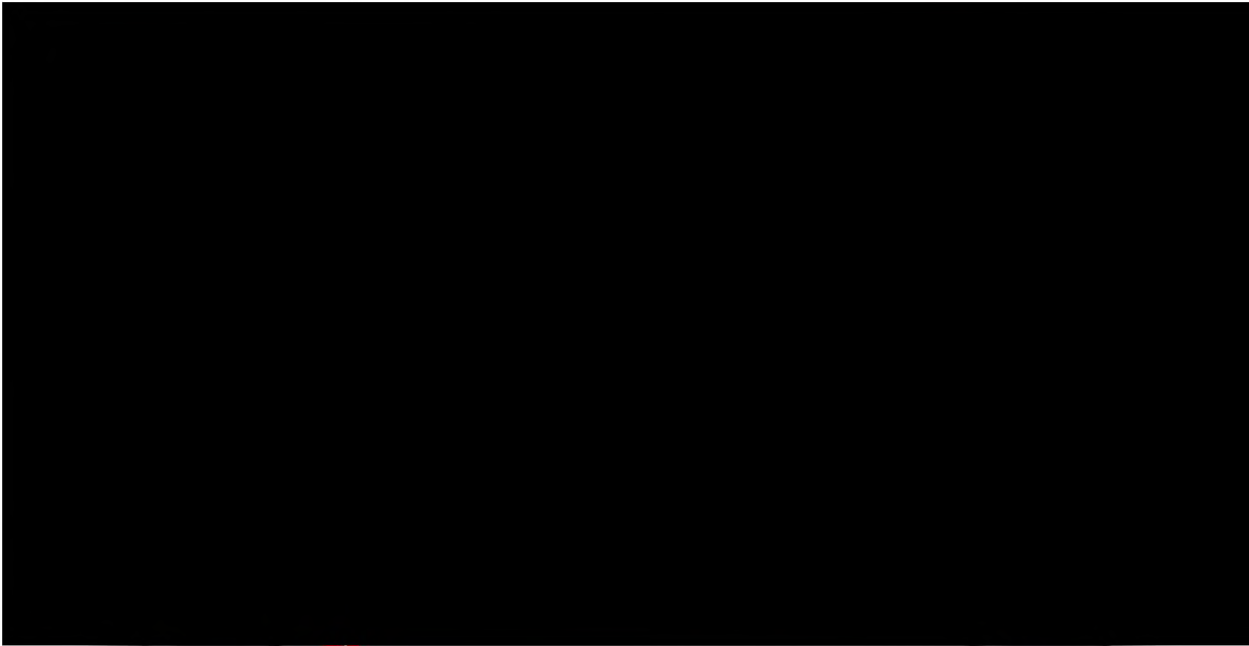
Quickly log and export data to Microsoft Excel for documentation or further analysis.

Remotely control your DMM via LAN

You can change your instrument settings and perform measurements remotely with built-in LAN connectivity.



Intuitive Front Panel



Label	Description
1	On/off switch
2	Display
3	USB host
4	Measurement function keys
5	Soft keys
6	Range change keys
7	Input terminals
8	Fuse

Spec Interpretation Guide

The following pages list the technical specifications for the Keysight EDU34450A DMM. The following explanations and examples are helpful in understanding how to interpret these specifications:

- Measurement accuracy is specified as the percentage of reading plus the percentage of range, where reading is the actual measured value and range is the name of the scale (1 V, 10 V, and so on) — not the full-scale value (1.2 V, 12 V, and so on).
- Accuracies are listed as one-year specifications. This refers to the length of time since the instrument's last calibration.

Example 1: Basic DC voltage accuracy

Calculate the accuracy of the following measurement: 9 V DC input, 10 V DC range, one-year accuracy specifications, standard operating temperature (18 – 28 °C).

From the following page, the one-year accuracy is 0.025% of reading + 0.005% of range.

It translates to this: $(0.025/100 \times 9 \text{ V}) + (0.005/100 \times 10 \text{ V}) = 2.75 \text{ mV}$

Total accuracy is **2.75 mV/9 V = 0.0306%**.

Example 2: Extreme operating temperature

When the EDU34450A operates outside of its 18 – 28 °C temperature range, you need to consider additional temperature drift errors. Assume the same conditions in Example 1 but at a 35 °C operating temperature.

The basic accuracy is again 0.025% of reading + 0.005% of range = 2.75 mV.

Now, multiply the 10 V temperature coefficient from the DC voltage specifications table by the number of degrees outside of operating range for additional error:

$$(0.0020\% \text{ reading} + 0.0008\% \text{ range}) / ^\circ\text{C} \times (35 - 28 ^\circ\text{C})$$

$$= (0.0020\% \text{ reading} + 0.0008\% \text{ range}) / ^\circ\text{C} \times 7 ^\circ\text{C}$$

$$= 0.014\% \text{ reading} + 0.0056\% \text{ range} = 1.82 \text{ mV}$$

Total error is **2.75 mV + 1.82 mV = 4.57 mV or 0.0508%**.

Example 3: AC voltage accuracy

The AC voltage function measures the true RMS value of the input waveform, regardless of waveshape. Listed accuracies assume a sine-wave input. To adjust accuracies for non-sinusoids, use the listed crest factor adder.

For this example, assume a $\pm 1 \text{ V}$ square wave input with a 50% duty cycle and a 1 kHz frequency.

Accuracy for **1 V, 1 kHz sinusoid is 0.2% reading + 0.1% range = 3 mV or 0.3%**.

EDU34450A Accuracy Specifications

Specifications are for 90-minute warm-up time, slow mode, NULL function enabled, and calibration temperature within 18 – 28 °C (unless stated otherwise).

DC specifications

Accuracy $\pm$ (% of reading + % of range):

Function	Range ¹	Test current or burden voltage	Input impedance	1 year 23 °C $\pm$ 5 °C	Temperature coefficient / °C 0 °C – 18 °C 28 °C – 55 °C
DC voltage	100.000 mV	-	10 M Ω or > 10 G Ω	0.018 + 0.008	0.0020 + 0.0008
	1.00000 V	-	10 M Ω or > 10 G Ω	0.015 + 0.005	0.0015 + 0.0008
	10.0000 V	-	10 M Ω	0.025 + 0.005	0.0020 + 0.0008
	100.000 V	-	10 M Ω	0.025 + 0.005	0.0020 + 0.0008
	1000.00 V	-	10 M Ω	0.027 + 0.005	0.0020 + 0.0008
Resistance ²	100.000 Ω	1 mA	-	0.065 + 0.010	0.0080 + 0.0008
	1.00000 k Ω	500 μ A	-	0.065 + 0.008	0.0080 + 0.0005
	10.0000 k Ω	100 μ A	-	0.065 + 0.005	0.0080 + 0.0005
	100.000 k Ω	10 μ A	-	0.065 + 0.005	0.0080 + 0.0005
	1.00000 M Ω	1 μ A	-	0.065 + 0.005	0.0080 + 0.0005
	10.0000 M Ω	100 nA	-	0.300 + 0.005	0.0250 + 0.0005
	100.000 M Ω	100 nA / 10 M Ω	-	2.000 + 0.005	0.3000 + 0.0005
DC current ³	10.0000 mA	< 0.02 V	-	0.10 + 0.015	0.008 + 0.0015
	100.000 mA	< 0.2 V	-	0.10 + 0.007	0.008 + 0.0010
	1.00000 A	< 0.3 V	-	0.30 + 0.015	0.019 + 0.0015
	3.0000 A ⁶	< 0.9 V	-	0.30 + 0.007	0.019 + 0.0010
Continuity ⁴	1000 Ω	0.5 mA	-	0.1 + 0.1	0.009 + 0.005
Diode test ⁵	1.0000 V	0.5 mA	-	0.05 + 0.10	0.005 + 0.005

¹ 20% over range on all ranges except 1,000 VDC and 3 A range.

² Specifications are for four-wire Ω or two-wire Ω using the NULL function. If without NULL function, add 0.2 Ω additional error. For 1 M Ω , 10 M Ω , and 100 M Ω ranges, accuracy may be degraded when humidity is > 60% RH.

³ For 10 mA and 100 mA ranges, allow the internal current sense resistor to cool after measuring > 1 A for more than 15 mins.

⁴ Typical specifications. The continuity threshold is fixed at less than 10 Ω . Available in fast mode only.

⁵ Typical specifications. Specifications are for the voltage measured at the input terminals only. Available in fast mode only.

⁶ Specification applies with a settling time of (10*Current²) seconds. (E.g.: DCI: 1 A will require 10 s settling time.)

AC specifications

Accuracy $\pm$ (% of reading + % of range):

Function	Range ¹	Frequency	1 year 23 °C $\pm$ 5 °C	Temperature coefficient / °C 0 °C – 18 °C 28 °C – 55 °C
True RMS AC voltage ²	100.000 mV	20 Hz – 45 Hz	1.0 + 0.1	0.02 + 0.02
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02
		10 kHz – 30 kHz	1.5 + 0.3	0.05 + 0.02
		30 kHz – 100 kHz ³	6.0 + 0.3	-
	1.000 00V to 750.00 V	20 Hz – 45 Hz	1.0 + 0.1 ⁴	0.02 + 0.02
		45 Hz – 10 kHz	0.2 + 0.1	0.02 + 0.02
		10 kHz – 30 kHz	1.5 + 0.3	0.05 + 0.02
		30 kHz – 100 kHz ³	3.0 + 0.3 ⁵	0.10 + 0.02
True RMS AC current ²	10.0000 mA to 3.000 0A ⁶	20 Hz – 45 Hz	1.5 + 0.1	0.02 + 0.02
		45 Hz – 1 kHz	0.5 + 0.1	0.02 + 0.02
		1 kHz – 10 kHz ⁷	2.0 + 0.2	0.02 + 0.02

- 20% over range on all ranges except ACV 750 V and ACI 3 A.
- Specifications are for sine-wave inputs more than 5% of the range, except the 750 V range. Input signal must be more than 50 Vrms for the 750 V range. Maximum crest factor of 3 at full scale. Input impedance is at least 1.1 M Ω in parallel with capacitance less than 100 pF, AC couple with up to 400 DCV.
- Typical specification for 100 mV range. Additional error to be added as frequency > 30 kHz and signal input < 10% of range. 30 kHz to 100 kHz: 0.003% of range per 4 kHz
- For input < 200 V rms.
- For input < 300 V rms. 4.5% of reading + 0.3 % of range (typical specification) for 750 V range.
- For 10 mA and 100 mA ranges, allow internal current sense resistor to cool if applied > 1 A for more than 15 mins.
- Frequencies > 5 kHz are typical for 1 A and 3 A ranges.

Frequency accuracy $\pm$ (% of reading + 3 counts):

Function	Range ¹	Frequency	1 year 23 °C $\pm$ 5 °C	Temperature coefficient / °C 0 °C – 18 °C 28 °C – 55 °C
Frequency	100.000 mV to 750.00 V	20 Hz – 300 kHz ²	0.025 + 3	0.005
	10.0000 mA to 3.0000 A	20 Hz – 10 kHz ³	0.025 + 3	0.005

- The frequency can be measured up to 1 MHz as 0.5 V signal to 100 mV/1 V ranges.
- 10% of range to full-scale input on all ranges, except where noted. 100 mV range specifications are for full-scale or greater inputs. For inputs from 10 mV to 100 mV in 100 mV range, multiply the total percentage of reading error by 10.
- 10% of range to full-scale input on all ranges, except where noted. 10 mA range specifications are for full-scale or greater inputs. For inputs from 1 mA to 10 mA in 10 mA range, multiply the total percentage of reading error by 10.

Frequency resolution:

Function	Range ¹	Frequency	Resolution
Frequency	100.000 mV to 750.00 V 10.0000 mA to 3.0000 A	012.000 Hz - 119.999 Hz	0.001 Hz
		0.12000 kHz - 1.19999 kHz	0.00001 kHz
		1.2000 kHz - 11.9999 kHz	0.0001 kHz
		12.000 kHz - 119.999 kHz	0.001 kHz
		0.12000 MHz - 1.19999 MHz	0.00001 MHz

- The frequency can be measured up to 1 MHz as 0.5 V signal to 100 mV/1 V ranges.

Temperature and capacitance specifications

Accuracy $\pm$ (% of reading + % of range):

Function	Range ¹	Probe type or test current	1 year 23 °C $\pm$ 5 °C	Temperature coefficient / °C 0 °C – 18 °C 28 °C – 55 °C
Temperature ²	-80.0 °C to 150 °C	5 k Ω thermistor probe	Probe accuracy + 0.2 °C	0.0020 °C
	-110.0 °F to 300.0 °F	5 k Ω thermistor probe	Probe accuracy + 0.4 °F	0.0036 °F
Capacitance	1.000 nF	100 nA	-	-
	10.00 nF ²	100 nA	1 + 1.5	0.04 + 0.015
	100.0 nF	1 μ A	1 + 0.5	0.02 + 0.001
	1.000 μ F	1 μ A	1 + 0.5	0.02 + 0.001
	10.00 μ F	10 μ A	1 + 0.5	0.02 + 0.001
	100.0 μ F	100 μ A	1 + 0.5	0.02 + 0.001
	1.000 mF	500 μ A	1 + 0.5	0.02 + 0.001
	10.00 mF	1 mA	2 + 0.5	0.02 + 0.001

1. 20% over range on all ranges. Specifications apply after NULL of open test leads connected to input terminals.

2. Typical specification.



System characteristics

System specifications on single display (typical):

Function	Resolution (digit)	Function change (sec) ¹	Range change (sec) ²	Auto range (sec) ³	Reading rate / sec ⁴ (USB)	Reading rate / sec ⁴ (LAN)
ACV	Slow (5.5)	2.6	2.5	4.6	1.9	1.9
	Medium (4.5)	1.2	1.2	1.5	19	19
	Fast (4.5)	1.1	1.1	1.2	90	43
DCV	Slow (5.5)	1.4	1.4	1.6	1.3	1.3
	Medium (4.5)	0.6	0.7	0.8	49	36
	Fast (4.5)	0.6	0.7	0.7	110	48
2-wire Ω	Slow (5.5)	1.3	2.6	1.6	1.4	1.4
	Medium (4.5)	0.7	1.0	0.6	49	36
	Fast (4.5)	0.7	1.0	0.5	110	46
4-wire Ω	Slow (5.5)	1.8	1.4	1.9	1	1
	Medium (4.5)	1.1	0.6	1.1	5.2	5.0
	Fast (4.5)	1.1	0.6	1	5.9	5.4
Frequency ⁵	Slow (5.5)	2.1	2.1	2.6	0.9	0.9
	Medium (4.5)	1.2	1.2	1.7	9.0	9.0
	Fast (4.5)	-	-	-	-	-
ACI	Slow (5.5)	2.6	2.6	6.2	1.9	1.9
	Medium (4.5)	1.2	1.2	1.7	19	19
	Fast (4.5)	1.1	1.2	1.3	90	45
DCI	Slow (5.5)	1.3	1.3	1.9	1.7	1.7
	Medium (4.5)	0.6	0.7	0.9	49	42
	Fast (4.5)	0.6	0.7	0.7	110	48
Diode test	4.5	0.1	-	-	110	48
Continuity	4.5	0.6	-	-	110	47
Temperature	4.5	1.8	-	-	4.5	4.2
Capacitance	4.5	-	-	-	-	-

1. Time to change from two-wire resistance to this specified function and to take at least one reading using SCPI "FUNC" and "READ?" commands.
2. Time to change from one range to the next higher range and to take at least one reading using SCPI "RANGE" and "READ?" commands.
3. Time to automatically change one range and to take at least one reading using SCPI "CONF AUTO" and "READ?" commands.
4. Number of measurements using SCPI "READ?" command when the front-panel display is off using "DISP OFF" command.
5. Reading rate depends on signal frequency ≥ 20 Hz.

Supplemental measurement characteristics

Measurement	Characteristic	
DC voltage	Measurement method	
	Input resistance	> 10 G Ω (selectable 100 mV, 1 V ranges) 10 M Ω (typical)
	Input protection	1,000 V on all ranges (HI terminal)
Resistance	Measurement method	Selectable 4-wire or 2-wire ohms. Current source referenced to LO input
	Open circuit voltage	Limited to < 2.8 V
	Input protection	1,000 V on all ranges (HI terminal)
DC current	Shunt resistance	1 Ω for 10 mA, 100 mA ranges 0.1 Ω for 1 A, 3 A ranges
	Input protection	Externally accessible at front panel 4 A, 600 V fuse for I terminal
	Measurement method	Uses 0.5 mA constant current source
Continuity / diode test	Response time	Continuity: 100 samples/second with audible tone Diode: 100 samples/second with audible tone
	Continuity threshold	10 Ω fixed
	Input protection	1000 V (HI terminal)
Temperature	Measurement method	2-wire ohms measurement of 5 k Ω thermistor sensor (YSI 44007 or equivalent) with a 25 °C / 125 °C ratio of 29.26 Auto-ranging measurement, no manual range selection
	Input protection	1000 V (HI terminal)
Measurement noise rejection	CMR (common mode rejection) For 1 k Ω unbalance LO lead	DC 140 dB AC 70 dB
	NMR (normal mode rejection) For 60 Hz (50 Hz) $\pm$ 0.1%	Slow mode 5½ digits, 60 dB medium mode: 4½ digits, 60 dB Fast mode: 4½ digits, 0 dB
AC voltage	Measurement method	AC coupled True-RMS – measures the AC component with up to 400 VDC bias on any range
	Crest factor	Maximum 3:1 at full scale
	Input impedance	> 1.1 M Ω in parallel with < 100 pF of all ranges
AC current	Input protection	750 V rms on all ranges (HI terminal)
	Measurement method	DC coupled to the fuse and current shunt; AC coupled true-RMS measurement (measures the AC component only)
	Shunt resistance	1 Ω for 10 mA, 100 mA ranges 0.1 Ω for 1 A, 3 A ranges
	Input protection	Externally accessible at front panel 4 A, 600 V fuse for I terminal
Frequency	Measurement method	Reciprocal counting technique; AC coupled input using AC voltage function
	Signal level	10% of range to full-scale input on ranges except where noted. Auto or manual range selection
	Gate time	0.1 second or 1 second gate time
	Input protection	750 V rms on all ranges (HI terminal)
Math functions	Null, dBm, dB, Min/Max/Avg, hold limit test	
Data log	Info, list	
Triggering and memory	Samples per trigger	1 to 5,000 (typical)
	Trigger delay	0 to 3,600 sec (100 μ s step size)
Non-volatile memory	5,000 readings	
Sample timer	Range	
Remote interface	USB, LAN standard	
Programming language	SCPI-1994.0, IEEE-488 2	

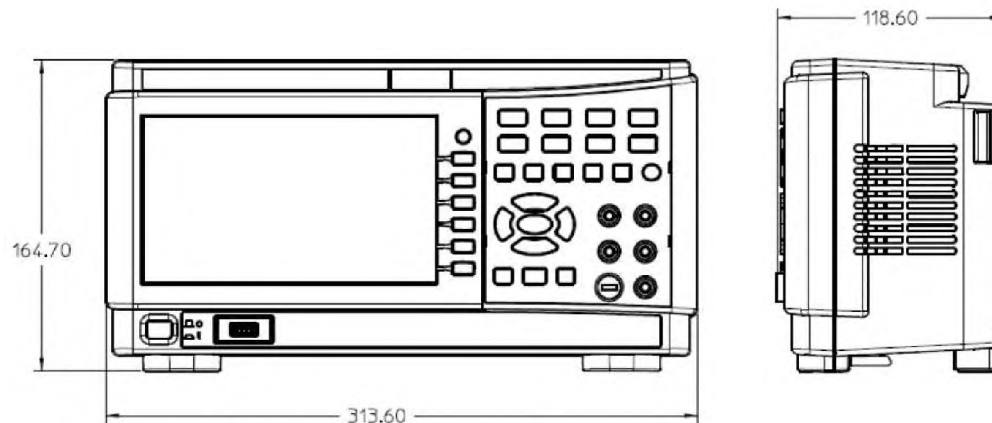
Rear Panel at a Glance



General characteristics

Characteristics	
Power supply	100 V / 120 V (127 V) / 220 V (230 V) / 240 V $\pm$ 10% AC line frequency 45 Hz – 66 Hz, automatically sensed at power on
Power consumption	13 VA maximum, < 6.6 W average
Operating environment	Full accuracy to 80% RH for 0 °C to 30 °C (non-condensing) Full accuracy to 40% RH for 30 °C to 55 °C (non-condensing) Altitude up to 3000 meters
Operating temperature	Full accuracy for 0 °C to 55 °C
Storage temperature	- 40 °C to 70 °C
Safety and EMC compliance	Refer to Declaration of Conformity for the latest revisions of regulatory compliance at: www.keysight.com/go/conformity
Measurement category	CAT II, 300 V: CAT I 1000 Vdc 750 Vac rms, 2,500 Vpk transient over-voltages, pollution degree 2
Shock and vibration	Tested to IEC/EN 60086-2
Dimensions (HxWxD)	165 mm x 314 mm x 119 mm (6.5 in x 12.6 in x 4.7 in)
Weight	3.35 kg
Warm-up time	90 minutes

Dimensions (mm)



Ordering Information

Digital multimeter

EDU34450A 5½-digit DMM

Standard shipped items

Power cord, test leads

Keysight optional accessories

EDU190A	Instrument stacking kit (to use with other education series instruments)
34138A	Test lead set
E2308A	Thermistor temperature probe
34330A	30 A current shunt

Other education series products

EDU33211A	Waveform generator, 20 MHz, one channel
EDU33212A	Waveform generator, 20 MHz, two channels
EDU36311A	DC power supply, triple output
EDUX1052A	InfiniiVision 1000 X-Series oscilloscope, 50 MHz, analog channels
EDUX1052G	InfiniiVision 1000 X-Series oscilloscope, 50 MHz, analog channels, with a built-in waveform generator

To learn more, please visit:

www.keysight.com/find/EDU34450A





RIGOL

DHO800_{Series}

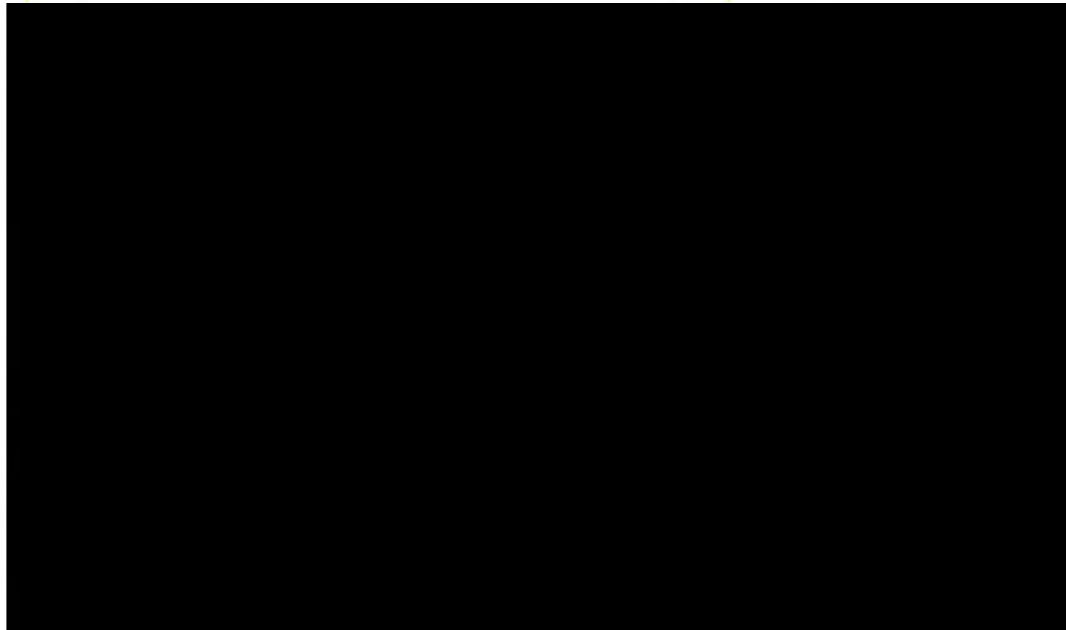
Digital Oscilloscope

Data Sheet
DSA36106-1110
Oct.2024

DHO800 Series Digital Oscilloscope

Compact Size, Various Interfaces

7" Capacitive Multi-touch Screen



265.35 mm (W) × 161.75 mm (H) × 77.38 mm (D)



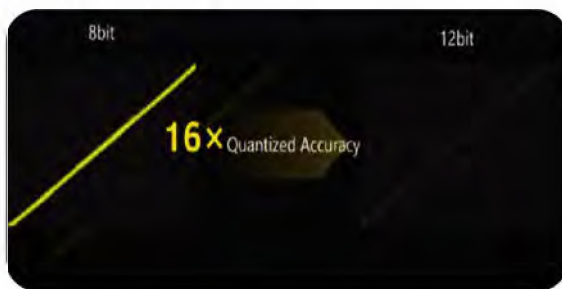
Application Scenarios

It is compact and portable, easy to be used on the workbench, in the classroom, on the test site, and in other application scenarios.

Its compact and delicate design makes it easy to carry and operate. You can put it on the workbench, with supporting legs folded or unfolded; put it flat on the workbench; or fix its rear panel to the desktop clamp-on stand to save room.

Technical Advantage

12-bit High Resolution



12-bit vertical resolution provides 4096 vertical digitizing levels

16 times the vertical digitizing level of the 8-bit resolution

Easy for users to test and see the small signals

Type-C Interface



Provides power with the mobile power supply via this interface, making the on-site test more flexible.

A



The [redacted] may lead to problems in the embedded design. The DHO800 series is equipped with a standard configuration of protocol triggers and decodes, capable of capturing the bus event accurately to check whether the serial communication link between devices runs properly.

com [redacted] the problem and make some modifications. With the auto measurement, math operation, protocol trigger and decode, the DHO800 series enables you to debug the problems with a high speed and locate the problem accurately.

able entry-level price. The brand new DHO800 series supports touch screen operation and the traditional convenient panel operation. It is an ideal high-precision oscilloscope with 12-bit measurement accuracy at an affordable price for your lab.

Product Features

Product Features

- Ultra-low noise floor, purer signal, never miss the small signals
- Up to 12 bits resolution for all the models of this series
- Max. analog bandwidth of 100 MHz, 4 analog channels, external trigger output (std.) available for the dual-channel model
- Max. real-time sample rate of 1.25 GSa/s
- Max. memory depth of 25 Mpts
- Vertical sensitivity range: 500 μ V/div to 10 V/div
- Max. capture rate of 1,000,000 wfms/s (in UltraAcquire mode)
- Digital phosphor display with real-time 256-level intensity grading
- Waveform search and navigation function allows you to debug the signal anomalies faster
- 7" (1024x600) capacitive multi-touch screen
- Brand new Flex Knob brings user-friendly experience
- USB Device & Host, LAN, and HDMI interfaces (std.) for all the models of this series
- Novel and delicate industrial design, easy to operate
- Unique online upgrade

The DHO800 series is RIGOL's new launched high-performance economical digital oscilloscope. Though compact in design, it has superior performance. It features a capture rate up to 1,000,000 wfms/s (in UltraAcquire Mode), 25 Mpts memory depth, 12 bit resolution, and low noise.

The DHO800 series is a brand new economical digital oscilloscope designed for the vast mainstream digital oscilloscope market to meet their design, debugging, and test demands.

RIGOL Probes and Accessories Supported

Model	Type	Description
Passive High-impedance Probe		
 PVP2150	Passive High-impedance Probe	- Attenuation Ratio: 10:1/1:1 1X BW: DC to 35 MHz 10X BW: DC to 150 MHz - Compatibility: All models of RIGOL's digital oscilloscopes
 PVP2350	Passive High-impedance Probe	- Attenuation Ratio: 10:1/1:1 1X BW: DC to 35 MHz 10X BW: DC to 350 MHz - Compatibility: All models of RIGOL's digital oscilloscopes
 PVP3150	Passive High-impedance Probe	- Attenuation Ratio: 10:1/1:1 1X BW: DC to 20 MHz 10X BW: DC to 150 MHz - Compatibility: All models of RIGOL's digital oscilloscopes
High-voltage Single-ended Probe		
 RP1010H	High-voltage Probe	- Attenuation Ratio: 1000:1 - BW: DC to 40 MHz - DC: 0 to 10 kV DC - AC: pulse ≤ 20 kVp-p - AC: sine ≤ 7 kV_{rms} - Compatibility: All models of RIGOL's digital oscilloscopes
 RP1018H	High-voltage Probe	- Attenuation Ratio: 1000:1 - BW: DC to 150 MHz - DC+AC_{peak}: 18 kV CAT II - AC_{rms}: 12 kV CAT II - Compatibility: All models of RIGOL's digital oscilloscopes

Model	Type	Description
 RP1300H	High-voltage Probe	• Attenuation Ratio: 100:1 • BW: DC to 300 MHz • CAT I 2000 V (DC+AC) • CAT II 1500 V (DC+AC) • Compatibility: All models of RIGOL's digital oscilloscopes
High-voltage Differential Probe		
 PHA0150	High-voltage Differential Probe	• BW: DC to 70 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA1150	High-voltage Differential Probe	• BW: DC to 100 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 PHA2150	High-voltage Differential Probe	• 50X BW: DC to 160 MHz • 500X BW: DC to 200 MHz • Max. voltage ≤ 1500 Vpp • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1025D	High-voltage Differential Probe	• BW: DC to 25 MHz • Max. voltage ≤ 1400 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1050D	High-voltage Differential Probe	• BW: DC to 50 MHz • Max. voltage ≤ 7000 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes
 RP1100D	High-voltage Differential Probe	• BW: DC to 100 MHz • Max. voltage ≤ 7000 Vpp (DC + AC P-P) • Compatibility: All models of RIGOL's digital oscilloscopes

Model	Type	Description
Current Probe		
 RP1001C	Current Probe	- BW: DC to 300 kHz - Maximum Input - AC: ± 100 A - AC P-P: 200 A - AC RMS: 70 A - Compatibility: All models of RIGOL's digital oscilloscopes
 RP1002C	Current Probe	- BW: DC to 1 MHz - Maximum Input - AC: ± 70 A - AC P-P: 140 A - AC RMS: 50 A - Compatibility: All models of RIGOL's digital oscilloscopes
 RP1003C	Current Probe	- BW: DC to 50 MHz - Maximum Input - AC P-P: 50 A (non-continuous) - AC RMS: 30 A - Compatibility: All models of RIGOL's digital oscilloscopes - Required to order RP1000P power supply.
 RP1004C	Current Probe	- BW: DC to 100 MHz - Maximum Input - AC P-P: 50 A (non-continuous) - AC RMS: 30 A - Compatibility: All models of RIGOL's digital oscilloscopes - Required to order RP1000P power supply.
 RP1005C	Current Probe	- BW: DC to 10 MHz - Maximum Input - AC P-P: 300 A (non-continuous), 500 A (@pulse width ≤ 30 us) - AC RMS: 150 A - Compatibility: All models of RIGOL's digital oscilloscopes - Required to order RP1000P power supply.

Model	Type	Description
 RP1006C	Current Probe	• BW: DC to 2 MHz • Maximum Input AC P-P: 700 A peaks, non-continuous AC RMS: 500 A • Compatibility: All models of RIGOL's digital oscilloscopes • Required to order RP1000P power supply.
 RP1000P	4CH Power Supply	Power supply for RP1003C, RP1004C, RP1005C, and RP1006C; supporting 4 channels.

Specifications

All the specifications are guaranteed except the parameters marked with "Typical" and the oscilloscope needs to operate for more than 30 minutes under the specified operation temperature. The specifications are measured when the oscilloscope is properly grounded.

Overview of the DHO800 Series Technical Specifications

Overview of the DHO800 Series Technical Specifications				
Model	DHO802	DHO804	DHO812	DHO814
Analog Bandwidth (-3 dB)	70 MHz		100 MHz	
Rise Time (10% to 90%, typical)	≤5 ns		≤3.5 ns	
No. of Analog Channels	2 + EXT	4	2 + EXT	4
Sampling Mode	Real-time Sampling			
Max. Sample Rate of Analog Channel	Two-channel model: 1.25 GSa/s (single-channel ^[1]), 625 MSa/s (full-channel ^[3]) four-channel model: 1.25 GSa/s (single-channel ^[1]), 625 MSa/s (dual-channel ^[2]), 312.5 MSa/s (full-channel ^[3])			
Max. Memory Depth	Two-channel model: 25 Mpts (single-channel ^[1]), 10 Mpts (full-channel ^[3]) four-channel model: 25 Mpts (single-channel ^[1]), 10 Mpts (dual-channel ^[2]), 5 Mpts (full-channel ^[3])			
Max. Waveform Capture Rate	30,000 wfms/s (Vector Mode) 1,000,000 wfms/s (UltraAcquire Mode)			
Vertical Resolution	12 bits			
Hardware Real-time Waveform Recording and Playing	Max. 500,000 frames			
Peak Detection	Capture 1.6 ns glitches			
LCD Size and Type	7" capacitive multi-touch screen			

Overview of the DHO800 Series Technical Specifications

Display Resolution	1024x600
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Vertical System Analog Channel

Vertical System Analog Channel

Input Coupling	DC, AC, or GND	
Input Impedance	1 M Ω $\pm$ 1%	
Input Capacitance	15 pF $\pm$ 3 pF	
Probe Attenuation Coefficient	0.001X, 0.002X, 0.005X, 0.01X, 0.02X, 0.05X, 0.1X, 0.2X, 0.5X, 1X, 2X, 5X, 10X, 15X, 20X, 50X, 100X, 150X, 200X, 500X, 1000X, 1500X, 2000X, 5000X, 10000X, 15000X, 20000X, and 50000X	
Maximum Input Voltage	Remarks	CAT I 300 V _{rms} , 400 V _{pk} (DC + V _{peak})
		Whether the probe is used or not, the transient overvoltage is not allowed to occur. Please use the instrument dedicated for the specified measurement category (not applicable to CAT II, III, and IV)
Vertical Resolution	12 bits	
Vertical Sensitivity Range ^[4]	500 μ V/div to 10 V/div	
Offset Range	$\pm$ 0.5 V (<500 μ V/div)	
	$\pm$ 1 V ($\geq$ 500 μ V/div, $\leq$ 65 mV/div)	
	$\pm$ 8 V (>65 mV/div, $\leq$ 270 mV/div)	
	$\pm$ 20 V (>270 mV/div, $\leq$ 2.75 V/div)	
	$\pm$ 100 V (>2.75 V/div, $\leq$ 10 V/div)	
Dynamic Range	$\pm$ 4 div (12 bits)	
Bandwidth Limit (Typical)	20 MHz, FULL; selectable for each channel	
DC Gain Accuracy ^[4]	$\pm$ 1% (>5mV/div, FullScale)	
	$\pm$ 2% ($\leq$ 5mV/div, FullScale, Typ.)	
DC Offset Accuracy	$\leq$ 200 mV/div ($\pm$ 0.1 div $\pm$ 2 mV $\pm$ 1.5% of offset value)	
	>200 mV/div ($\pm$ 0.1 div $\pm$ 2 mV $\pm$ 1.0% of offset value)	

Vertical System Analog Channel

Channel-to-Channel Isolation	$\geq 100:1$
ESD Tolerance	± 8 kV (on input BNCs)

Horizontal System--Analog Channel**Horizontal System--Analog Channel**

Range of Time Base	5 ns/div to 500 s/div	
	Fine	
Time Base Resolution	100 ps	
Time Base Accuracy	± 25 ppm ± 5 ppm/year	
Time Base Delay Range	Pre-trigger	-5 div
	Post-trigger	1 s or 100 div, whichever is greater
Delta Time Accuracy	$\pm (\text{Time Base Accuracy} \times \text{Readout}) \pm (0.001 \times \text{Screen Width})$ ± 20 ps	
Channel-to-Channel Skew Correction	± 100 ns, Accuracy ± 1 ps	
Analog Channel-to-Channel Delay (Typical) ^[5]	≤ 2 ns	
Horizontal Mode	YT	Default
	XY	Channel 1/2/3/4
	SCAN	Time base ≥ 200 ms/div
	ROLL	Time base ≥ 50 ms/div, available to enter or exit the ROLL mode by adjusting the horizontal timebase knob

Acquisition System

Acquisition System

	Two-channel model:	
Max. Sample Rate of Analog Channel	1.25 GSa/s (single-channel ^[1]), 625 MSa/s (full-channel ^[3])	
	four-channel model:	
	1.25 GSa/s (single-channel ^[1]), 625 MSa/s (dual-channel ^[2]), 312.5 MSa/s (full-channel ^[3])	
Max. Memory Depth of Analog Channel	Two-channel model:	
	25 Mpts (dual-channel ^[2]), 10 Mpts (full-channel ^[3])	
	four-channel model:	
	25 Mpts (single-channel ^[1]), 10 Mpts (dual-channel ^[2]), 5 Mpts (full-channel ^[3])	
Acquisition Mode	Normal	Default
	Peak Detection	Capture 1.6 ns glitches
	Average Type	2, 4, 8, 16...65536 are available for you to choose
	UltraAcquire	Waveform capture rate up to 1,000,000 wfms/s

Trigger System

Trigger System

Trigger Source		Analog channel (CH1 to CH4), EXT TRIG ^[6]
Trigger Mode		Auto, Normal, Single
Trigger Coupling	DC	DC coupling trigger
	AC	AC coupling trigger
	High Frequency Rejection	Cut-off frequency to 120 kHz (internal trigger only)
	Low Frequency Rejection	Cut-off frequency to 120 kHz (internal trigger only)
Noise Rejection		Increases delay for the trigger circuit (internal trigger only), On/Off
Holdoff Range		8 ns to 10 s

Trigger System

Trigger Bandwidth	Internal trigger: analog bandwidth of the oscilloscope
Trigger Sensitivity	Internal trigger: 0.5 div, ≥ 50 mV/div; 0.7 div (with noise rejection enabled) External trigger ^[6] : 500 mVpp (DC to 100 MHz)
Trigger Level Range	Internal trigger: ± 4.5 div from the center of the screen External trigger ^[6] : ± 5 V

Trigger Type

Trigger Type

Trigger Type	Edge trigger, Pulse trigger, Slope trigger, Video trigger, Pattern trigger, Duration trigger, Timeout trigger, Runt trigger, Window trigger, Delay trigger, Setup/Hold trigger, Nth Edge trigger, RS232/UART, I2C, SPI, CAN
Edge	Triggers on the threshold of the specified edge of the input signal. The edge types can be Rising, Falling, or Either. Source channel: CH1 to CH4, and EXT ^[6]
Pulse	Triggers on the positive or negative pulse with a specified width. The pulse width is greater or smaller than a certain value or within a certain time range. Source channel: CH1 to CH4
Slope	Triggers on the positive or negative slope of the specified time. The slew time is greater or smaller than a certain value or within a certain time range. Source channel: CH1 to CH4
Video	Triggers on all lines, specified line, odd field, or even field that conforms to the video standards. The supported video standards include NTSC, PAL/SECAM, 480p/60Hz, 576p/50Hz, 720p/60Hz, 720p/50Hz, 720p/30Hz, 720p/25Hz, 720p/24Hz, 1080p/60Hz, 1080p/50Hz, 1080p/30Hz, 1080p/25Hz, 1080p/24Hz, 1080i/60Hz, and 1080i/50Hz. Source channel: CH1 to CH4
Pattern	Identifies a trigger condition by searching for a specified pattern. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, X, Rising, or Falling. Source channel: CH1 to CH4
Duration	Triggers when the specified pattern meets the specified duration condition. The pattern is a combination of multiple selected channel sources. The logic pattern of each channel is H, L, and X. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range. Source channel: CH1 to CH4

Trigger Type

Timeout	Triggers when duration of a certain event exceeds the specified time. The event can be specified as Rising, Falling, or Either. Source channel: CH1 to CH4
Runt	Triggers when the pulses pass through one threshold but fail to pass through another threshold. Source channel: CH1 to CH4
Window	Triggers in a specified window state when the rising edge of the signal crosses the upper threshold or the falling edge crosses the lower threshold. The window state can be Enter, Exit, or Time. Source channel: CH1 to CH4
Delay	Triggers when the time difference between the specified edges of Source A and Source B meets the preset time. The duration is greater or smaller than a certain value, or within a certain time range, or outside a certain time range. Source channel: CH1 to CH4
Setup/Hold	When the setup time or hold time between the input clock signal and the data signal is smaller than the specified time. Source channel: CH1 to CH4
Nth Edge	Triggers on the Nth edge that appears after the specified idle time. The edge can be specified as Rising or Falling. Source channel: CH1 to CH4
RS232/UART	Triggers on the Start, Error, Check Error, or Data frame of the RS232/UART bus (up to 20 Mb/s). Source channel: CH1 to CH4
I2C	Triggers on the Start, Stop, Restart, MissedACK, Address (7 bits, 8 bits, or 10 bits), Data, or Address Data of the I2C bus. Source channel: CH1 to CH4
SPI	Triggers on the specified pattern of the specified data width (4 to 32) of SPI bus. CS ^[7] and Timeout are supported. Source channel: CH1 to CH4
CAN	Triggers on the start of a frame, end of a frame, Remote ID, Overload, Frame ID, Frame Data, Data&ID, Frame Error, Answer Error, Check Error, Format Error, Bit Fill, and Random of the CAN signal (up to 5Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4, D0 to D15

Search&Navigation**Search&Navigation**

Type	Edge, Pulse
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Search&Navigation

Source	Analog channel
Copy	Copies the search settings from or to the trigger settings mutually, including threshold setting and search condition settings
Result Display	Displays in event table form; can be exported to the external or internal memory
Navigation	Time navigation: navigates to the acquired waveforms in time order.
	Event navigation: uses the navigation keys to scroll through the event search results and navigates to the specified event.
	Frame navigation: navigates to the specified frame segment in UltraAcquire mode.

Waveform Measurement

Waveform Measurement

Cursor	Number of Cursors	2 pairs of XY cursors
	Manual Mode	Voltage deviation between cursors (ΔY)
		Time deviation between cursors (ΔX)
		Reciprocal of ΔX (Hz) ($1/\Delta X$)
	Track Mode	Fixes Y-axis to track X-axis waveform point's voltage and time values Fixes X-axis to track Y-axis waveform point's voltage and time values
	Auto Measurement	Allows to display cursors during auto measurement
	XY Mode	Measures the voltage parameters of the corresponding channel waveforms in XY time base mode. X = Channel 1, Y = Channel 2

Waveform Measurement

Auto Measurement	Number of Measurements	41 auto measurements; and up to 10 measurements can be displayed at a time.
	Measurement Source	CH1 to CH4, Math1 to Math4
	Measurement Range (Region)	Main, Zoom
	All Measurement	Displays 33 measurement items (vertical and horizontal) for the current measurement channel; the measurement results are updated continuously.
	Vertical	Vmax, Vmin, Vpp, Vtop, Vbase, Vamp, Vupper, Vmid, Vlower, Vavg, VRMS, Per. VRMS, Overshoot, Preshoot, Area, and Period Area.
	Horizontal	Period, Frequency, Rise Time, Fall Time, +Width, -Width, +Duty, -Duty, Positive Pulse Count, Negative Pulse Count, Rising Edge Count, Falling Edge Count, Tvmax, Tvmin, +Slew Rate, and -Slew Rate
	Others	Delay(A↑-B↑), Delay(A↑-B↓), Delay(A↓-B↑), Delay(A↓-B↓), Phase(A↑-B↑), Phase(A↑-B↓), Phase(A↓-B↑), and Phase(A↓-B↓)

Waveform Calculation

Waveform Calculation

No. of Math Functions		4 math functions available to be displayed at a time
Operation		A+B, A-B, A×B, A/B, FFT, A&&B, A B, A^B, !A, Intg, Diff, Sqrt, Lg, Ln, Exp, Abs, AX+B, LowPass, HighPass, BandPass, and BandStop
Color Grade		Supports FFT
FFT	Record Length	Max. 1 Mpts (The max. number of the points to be analyzed for the FFT operation is 1 Mpts.)
	Window Type	Rectangular, Blackman-Harris, Hanning (default), Hamming, Flattop, and Triangle.
	Peak Search	A maximum of 15 peaks, determined by the user-defined threshold and offset threshold

Waveform Analysis

Waveform Analysis

Waveform Recording		Stores the signal under test in segments according to the trigger events, that is, saves all the sampled waveform data as a segment to the RAM for each trigger event. The maximum number of the sampled segments reaches 500,000.
	Source	All enabled analog channels
	Analysis	Support playing frame by frame or continuous playing; capable of calculating, measuring, and decoding the played waveforms
PassFail		Compares the signal under test with the user-defined mask to provide the test results: the number of successful tests, failed tests, and the total number of tests. The pass/fail event can enable immediate stop, beeper, and the screenshot.
	Source	Any analog channel
Histogram		The waveform histogram provides a group of data, showing the number of times a waveform hits within the defined region range on the screen. The waveform histogram not only shows the distribution of hits, but also the ordinary measurement statistics.
	Source	Any analog channel, auto measurement item
	Type	Horizontal, vertical, and measure
	Measure	Statistics: Sum, Peaks, Max, Min, Pk_Pk Histogram: Mean, Median, Mode, Bin width, Sigma, and XScale
	Sampling Mode	Supports all modes, except the Zoom, XY, and ROLL modes
Color Grade		Provides a dimensional view for waveform intensity, color grade >16, 256-level color scale display
	Source	Any analog channel
	Color Theme	Temperature and intensity
	Sampling Mode	Supports all modes

Serial Decoding

Serial Decoding	
Number of Decodings	4 protocol types can be decoded and enabled at the same time
Decoding Type	Standard: Parallel, RS232/UART, I2C, SPI, CAN
Parallel	Up to 4 bits of Parallel decoding, supporting any analog channel Support user-defined clock and auto clock settings. Source channel: CH1 to CH4
RS232/UART	Decodes the RS232/UART (up to 20 Mb/s) bus's TX/RX data (5-9 bits), parity (Odd, Even, or None), and stop bits (1-2 bits) Source channel: CH1 to CH4
I2C	Decodes the address (with or without the R/W bit) of the I2C bus, data, and ACK. Source channel: CH1 to CH4
SPI	Decodes the MISO/MOSI data (4-32 bits) of the SPI bus. The available mode includes "Timeout" and "CS" ^[7] . Source channel: CH1 to CH4
CAN	Decodes the remote frame (ID, byte number, CRC), overload frame, and data frame (standard/extended ID, control domain, data domain, CRC, and ACK) of the CAN bus (up to 5 Mb/s). The supported CAN bus signal types include CAN_H, CAN_L, TX/RX, and DIFF. Source channel: CH1 to CH4

Auto

Auto	
AutoScale	Min voltage > 10 mVpp, duty cycle > 1%, frequency > 35 Hz

Digital Voltmeter

Digital Voltmeter	
Source	Any analog channel
Function	DC, AC+DC _{rms} , AC _{rms}
Resolution	ACV/DCV: 3 digits
Limits Beeper	Sounds an alarm when the voltage value is within or outside of the limit range

High-precision Frequency Counter

High-precision Frequency Counter

Source	Any analog channel and EXT ^[6]	
Measure	Frequency, period, totalizer	
Counter	Resolution	3-6 digits, user-defined
	Max. Frequency	Max. analog bandwidth
Totalizer	48-bit totalizer	
	Counts the number of the rising edges	
Time Reference	Internal reference	

Command Set

Command Set

Common Commands Support	IEEE488.2 Standard
Error Message Definition	Error messages
Support Status Report Mechanism	Status Reporting
Support Syn Mechanism	Synchronization

Display

Display

LCD	7-inch capacitive multi-touch screen, gesture enabled operation
Resolution	1024×600 (Screen Region) 16:9
Graticule	10 horizontal divisions x 8 vertical divisions
Persistence	Off, Infinite, variable persistence (100 ms to 10 s)
Brightness	256 intensity levels (LCD, HDMI)

Processor System

Processor System

Processor	Cortex-A72 up to 1.8 GHz, 6-core processor
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Processor System

System Memory	4 GB RAM
Operating System	Android
Internal Non-volatile Memory	8 GB

I/O

I/O

USB2.0 Host		1 on the front panel
USB2.0 Device		1 on the rear panel
LAN		1 on the rear panel, 10/100 Base-T, supporting LXI-C
Web Remote Control		Supports Web Control interface (input the IP address of the oscilloscope into the Web browser to display the operation interface of the oscilloscope)
EXT Interface ^[6]	Trigger Input	1 on the front panel, BNC connector
		1 on the rear panel, BNC connector
	Output Interface	Vo (H) ≥ 2.5 V open circuit, ≥1.0 V 50 Ω to GND Vo (L) ≤ 0.7 V to load ≤4 mA, ≤0.25 V 50 Ω to GND
AUX OUT	Trigger Output	Outputs a pulse signal when the oscilloscope is triggered
	Pass/Fail	Output a pulse signal when a pass/fail event occurs. Supports user-defined pulse polarity and pulse time (100 ns to 10 ms)
HDMI	Video Output	1 on the rear panel, HDMI 1.4, A plug. It is used to connect to an external monitor or projector
Probe Compensation Output		1 kHz, 3 V _{pp} square waveform

Power Supply

Power Supply

Power Supply Interface	Type-C
Power Voltage	DC 15 V, 3 A

Power Supply

Power	Max. 45 W (when connected to various interfaces, USB storage device, active probes)
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Environment

Environment

Temperature Range	Operating	0°C to 50°C
	Non-operating	-30°C to +60°C
Humidity Range	Operating	below +30°C: ≤90% RH (without condensation)
		+30°C to +40°C, ≤75% RH (without condensation)
		+40°C to +50°C, ≤45% RH (without condensation)
	Non-operating	below 60°C: ≤90% RH (without condensation)
Altitude	Operating	below 3,000 m
	Non-operating	Below 15,000 m

Warranty and Calibration Interval

Warranty and Calibration Interval

Warranty	Three years for the mainframe, excluding the probes and accessories.
Recommended Calibration Interval	18 months

Regulations

Regulations		
Electromagnetic Compatibility	Compliant with EMC DIRECTIVE 2014/30/EU, compliant with or higher than the standards specified in IEC 61326-1:2013/EN 61326-1:2013 Group 1 Class A	
	CISPR 11/EN 55011	
	IEC 61000-4-2:2008/EN 61000-4-2	±4.0 kV (contact discharge), ±8.0 kV (air discharge)
	IEC 61000-4-3:2002/EN 61000-4-3	3 V/m (80 MHz to 1 GHz); 3 V/m (1.4 GHz to 2 GHz); 1 V/m (2.0 GHz to 2.7 GHz)
	IEC 61000-4-4:2004/EN 61000-4-4	1 kV power line
	IEC 61000-4-5:2001/EN 61000-4-5	0.5 kV (phase-to-neutral voltage); 1 kV (phase-to-earth voltage); 1 kV (neutral-to-earth voltage)
	IEC 61000-4-6:2003/EN 61000-4-6	3 V, 0.15-80 MHz
	IEC 61000-4-11:2004/EN 61000-4-11	Voltage dip: 0% UT during half cycle; 0% UT during 1 cycle ; 70% UT during 25 cycles short interruption: 0% UT during 250 cycles
Safety	EN 61010-1:2019	
	EN 61010-031:2015	
	IEC 61010-1:2016	
	IEC 61010-2-030:2017	
	UL 61010-1:2012 R7	
	UL 61010-2-31:2017 R2	
	CAN/CSA-22.2 No. 61010-1-12:2017	
	CAN/CSA-22.2 No. 61010-2-30:2018	
Vibration	CAN/CSA-22.2 No. 61010-031-07:201	
	Meets GB/T 6587; class 2 random	
	Meets MIL-PRF-28800F and IEC60068-2-6; class 3 random	

Regulations

	Meets GB/T 6587-2012; class 2 random
	Meets MIL-PRF-28800F and IEC 60068-2-27; class 3 random
Shock	In non-operating conditions: 30 g, half-sine wave, 11 ms duration, 3 shocks along the main axis, total of 18 shocks

Mechanical Characteristics

Mechanical Characteristics

Dimensions	265.35 mm (W) x 161.75 mm (H) x 77.38 mm (D)
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Weight ^[8]	Package excluded: 1.78 kg
	Package included: 2.78 kg

Non-volatile Memory

Non-volatile Memory

	Setup/Image	setup (*.stp), image (*.png, *.bmp, *.jpg)
Data/File Storage	Waveform Data	CSV waveform data (*.csv), binary waveform data (*.bin), list data (*.csv), and reference waveform data (*.ref, *.csv, *.bin)
Internal Capacity		8 GB
Reference Waveform		Displays 10 internal waveforms
Setting		Storage is limited by the capacity
USB Capacity		Supports the USB storage device that conforms to the industry standard

Note:

[1]: Single-channel mode: If any one of the channels is enabled, it is called single-channel mode.

[2]: Dual-channel mode: For four-channel models, if any two of the channels are enabled, it is called dual-channel mode.

[3]: Full-channel mode: For two-channel models, if all of the two channels are enabled, it is called full-channel mode; for four-channel models, if any three channels or all of the four channels are enabled, it is called full-channel mode.

[4]: 500 μ V/div is a magnification of 1 mV/div setting. For vertical accuracy calculations, use full scale of 8 mV.

[5]: For any channel, under the same input impedance with DC-coupled, the Volts/div setting is the same for 100 mV/div and 200 mV/div.

[6]: Only available for the two-channel models.

[7]: Only available for the four-channel models.

[8]: Standard configuration.

Order Information and Warranty Period

Order Information

Order Information	Order No.
Model	
100 MHz, 1.25 GSa/s, 25 Mpts, 4CH	DHO814
100 MHz, 1.25 GSa/s, 25 Mpts, 2CH	DHO812
70 MHz, 1.25 GSa/s, 25 Mpts, 4CH	DHO804
70 MHz, 1.25 GSa/s, 25 Mpts, 2CH	DHO802
Standard Accessories	
Power Adaptor Conforming to the Standard of the Destination Country	— —
Banana-Plug Ground Connecting Cable	— —
DHO814/DHO804: Passive Probe x4 (150 MHz)	PVP3150
DHO812/DHO802: Passive Probe x2 (150 MHz)	

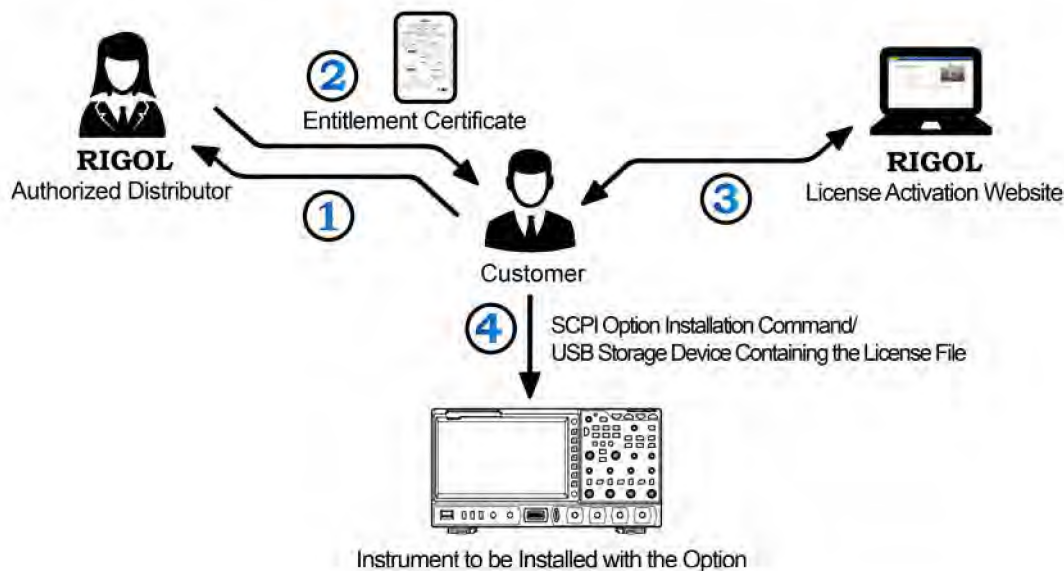
NOTE:

For all the mainframes, accessories and options, please contact the local office of RIGOL.

Warranty Period

Three years for the mainframe, excluding the probes and accessories.

Option Ordering and Installation Process



1. According to the usage requirements, please purchase the specified function options from **RIGOL Sales Personnel**, and provide the serial number of the instrument that needs to install the option.
2. After receiving the option order, the **RIGOL** factory will mail the paper software product entitlement certificate to the address provided in the order.
3. Log in to **RIGOL** official website for registration. Use the software key and instruments serial number provided in the entitlement certificate to obtain the option license code and the option license file.
4. Install the option by running the SCPI command concerning the option installation. You can also save the option license file to the root directory of the USB storage device. Then insert it to the instrument. After being recognized, follow the instructions to install the option.

NOTE:

If any problems occur during the option installation process, please contact **RIGOL** technical team.

Boost Smart World and Technology Innovation



- Cellular-5G/WIFI
- UWB/RFID/ ZIGBEE
- Digital Bus/Ethernet
- Optical Communication

- Digital/Analog/RF Chip
- Memory and MCU Chip
- Third-Generation Semiconductor
- Solar Photovoltaic Cells

- New Energy Automobile
- PV/Inverter
- Power Test
- Automotive Electronics

*Provide Testing and Measuring Products
and Solutions for Industry Customers*

[REDACTED]

[REDACTED]

[REDACTED]

PEL-500 Series

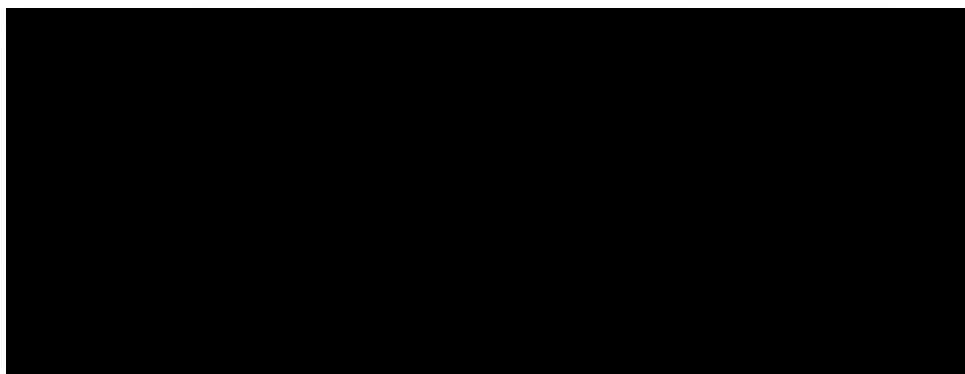
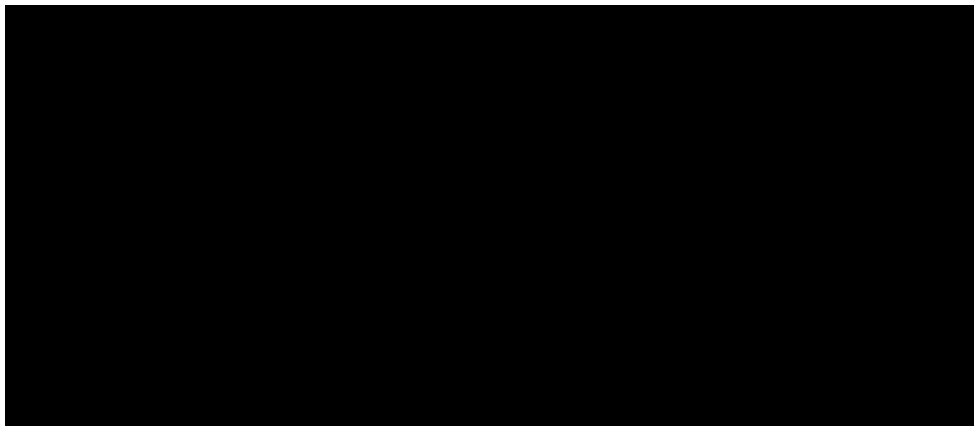
DC Electronic Load

FEATURES

- 5-digit Digital Voltage, Current and Power Meter
 - Simultaneous Display of Voltage, Current, and Watts
 - Short-circuit Time Can be Set During Short-circuit Test
 - Automatic Test Function of Overcurrent Protection/Overpower Protection
 - The Battery Discharge Test Function Can Set The Discharge Stop Voltage (V_{batt}), Discharge Capacity (Ah, Wh) and Stop Discharge Time
 - Surge Test Can Simulate Boot Overshoot Current and Transient Current From Hot Plugging
 - Constant Current, Constant Resistance, Constant Voltage, Constant Power and Dynamic Mode
 - Overvoltage, Overcurrent, Overpower, Over Temperature Protection and Reverse Polarity Detection
 - Voltage Polarity Display Can be Set to Positive Value ("+") or Negative Value ("-")
 - Communications Interface: RS-232, USB
-

GW INSTEK
Simply Reliable

DC Electronic Load



DESCRIPTIONS

- PEL-500 Series stand-alone load has its own control and display panel, CC / CR / CV / CP/ Dynamic modes, also can be controlled intranet via RS232 and USB interface
- SHORT time setting and SHORT_VH, SHORT_VL setting function, also can measure Short Voltage and Current
- Dynamic can be simulated under CC, CP mode. The current Rise / Fall slew rate can be adjusted individually
- The additional Short, OCP, OPP, Batt and Surge test function operated by both manual and remote that will be more efficiency and accuracy on Short, OCP, OPP, Batt and Surge testing
- Programmable loading voltage/unloading voltage, GO / NG meter check, Voltage polarity display can be set to positive value ("+") or negative value ("-") That is much advance feature for each different application

APPLICATIONS

- Voltage/Current Source Test
- Transient Response of Switching Power Supply
- Constant Voltage Mode for Current Limiting Test and Battery Simulation
- Battery Discharge
- R&D, Quality Control
- ATE System
- Production Test

DC Electronic Load

The PEL-500 series single-channel electronic load has a total of 5 models and provides 0~80V/ 0~500V voltage operating ranges and 250~700W power operating range. The series can be applied to R&D, quality control, ATE system and production test, including voltage source/current source test; switching power supply transient response; constant voltage mode for current limiting test; battery simulation; and battery discharge test.

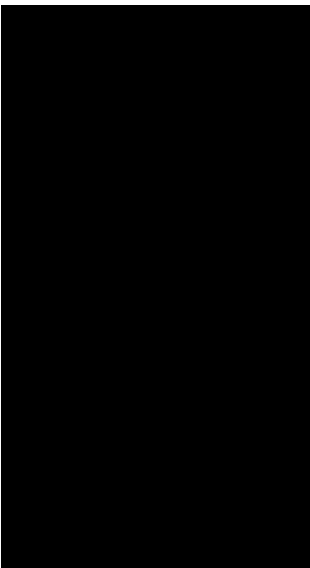
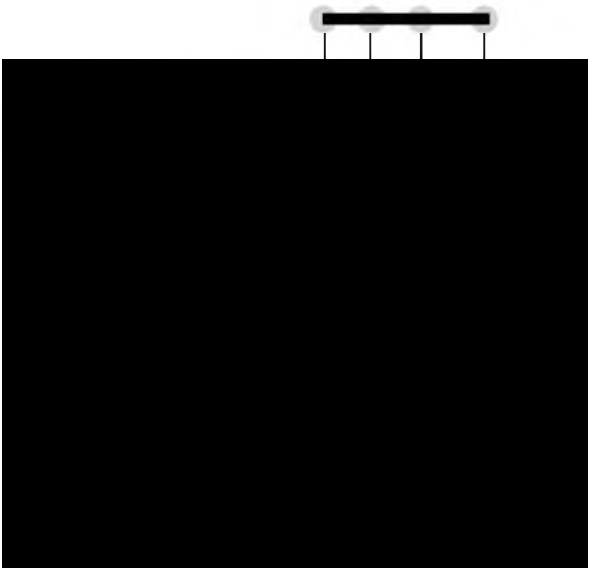
The PEL-500 series provides a 5-digit digital display of voltage, current and power. Users can monitor the measurement data of the DUT at the same time. In order to facilitate users to evaluate whether the DUT can withstand the overshoot current, the PEL-500 series provides Surge test, which can simulate the boot overshoot current and the transient current from hot plugging. The built-in battery discharge test function can determine the conditions for stopping the discharge according to the test requirements of the DUT, including setting the discharge stop voltage (Vbatt), discharge capacity (AH, WH) and stop discharge time.

Users can set the loading voltage/unloading voltage of the PEL-500 series for testing according to the characteristics of the DUT. When the output voltage of the DUT rises to the loading voltage value, the loading starts. When the output voltage drops to the unloading voltage, the loading ends. Users can use the GO/NG function to pre-set the judgment conditions according to the function and specifications of the DUT. The PEL-500 series will automatically generate the judgment results according to the set judgment conditions during the test.

Under the safety test requirements of the power supply, the PEL-500 series not only provides the Short test function, but also provides the automatic test function of overcurrent protection/overpower protection to simplify users' complicated manual operation and verify the OCP/OPP of the DUT's action points. The generated measurement results help users confirm whether the actual operating action points of the DUT for OCP/OPP are within the measurement regulations.

In addition to the function of providing load current waveforms to the oscilloscope via the BNC output terminal of Imonitor, the PEL-500 series also provides overvoltage, overcurrent, overpower and over temperature protection, and reverse polarity detection. When any one of them generates a trigger action, The PEL-500 series will have protective or reminding measures to protect the PEL-500 series from damage due to abnormal operating ranges.

PANEL INSTRUCTIONS



DC Electronic Load

PRODUCT DESCRIPTION

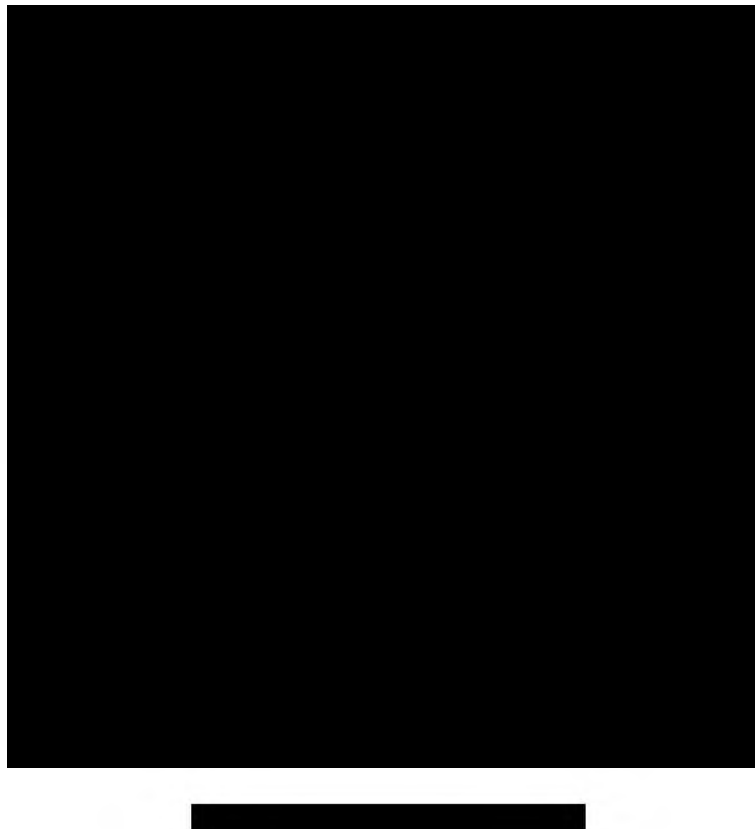
Surge Function

The Surge function allows users to set Surge current, Normal current, Surge Time and Surge STEP according to test requirements. Surge current and Normal current can be set from 0.000A to 50.400A, Surge Time can be set from 10 to 1000ms, and Surge STEP can be set from 1 to 5.



Battery Discharge Test Function

The battery discharge test function can determine the conditions to stop the discharge according to the test requirements of the DUT, including setting the stop discharge voltage (Vbatt), discharge capacity (AH, WH) and stop discharge time.



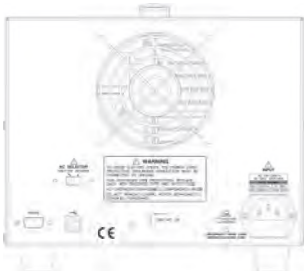
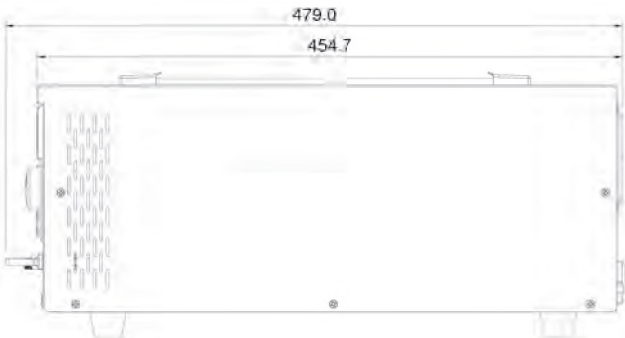
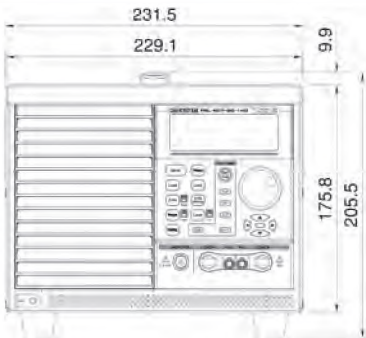
GO/NG Function

The GO/NG function is applied to monitor the test result. When the test result exceeds the preset upper/lower limit, the front panel display screen will display NG. Otherwise, GO is displayed. The GO/NG function can edit the working procedures of the test in CC mode/CR mode/CV mode/CP mode. After the test procedures are executed, the test result will be displayed on the front panel display screen, which is represented by GO or NG.

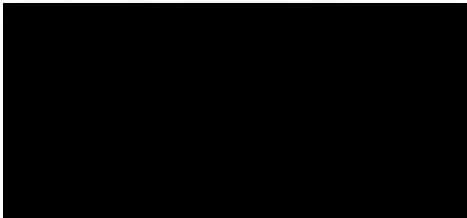
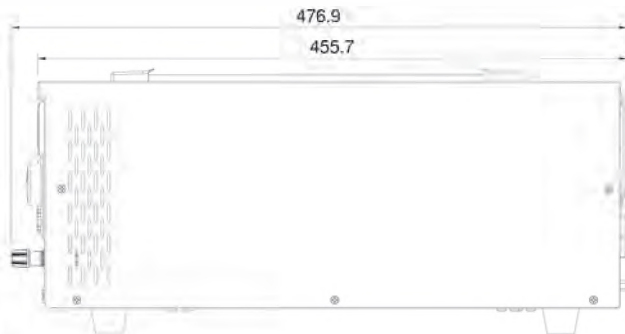
DC Electronic Load

Model		PEL-503-80-50		PEL-504-80-70		PEL-504-500-15		PEL-507-80-140		PEL-507-500-30	
INPUT RATINGS											
Power(Watt)		250 W		350 W		350 W		700 W		700 W	
Current(Ampere)		50 A		70 A		15 A		140 A		30 A	
Voltage(Volt)		80 V		80 V		500 V		80 V		500 V	
Min. Operating Voltage		1.0V @ 50A		1.2V @ 70A		6V @ 15A		0.9V @ 140A		3V @ 30A	
PROTECTIONS											
Over Power Protection(OPP)		≈262.5W		≈367.5W		≈367.5W		≈735W		≈735W	
Over Current Protection(OCP)		≈52.5A		≈73.5A		≈15.75A		≈147A		≈31.5A	
Over Voltage Protection(OVP)		≈84V		≈84V		≈525V		≈84V		≈525V	
Over Temp. Protection(OTP)		YES		YES		YES		YES		YES	
CC Mode											
Range		0-5.04-50.4A		0-7.02-70.2A		0-1.5-15A		0-14.04-140.4A		0-3-30A	
Resolution		0.084mA/0.84mA		0.117mA/1.17mA		0.025mA/0.25mA		0.234mA/2.34mA		0.05mA/ 0.5mA	
Accuracy		±0.1% of (SETTING + RANGE)									
CR Mode											
Range		0.016-1.6-96000Ω		0.0114-1.14-68400Ω		0.4-40-2400000Ω		0.0057-0.57-34200Ω		0.2-20-1200000Ω	
Resolution		26.666μΩ/0.010416mSiemens		19μΩ/0.014619mSiemens		666.667μΩ/0.416μSiemens		9.5μΩ/29.239μSiemens		333.334μΩ/0.833μSiemens	
Accuracy		±0.2% of (SETTING + RANGE)									
CV Mode											
Range		0-8.1-81V		0-8.1-81V		0-60-500V		0-8.1-81V		0-60-500V	
Resolution		0.135mV/1.35mV		0.135mV/1.35mV		1mV/10mV		0.135mV/1.35mV		1mV/10mV	
Accuracy		±0.05% of (SETTING + RANGE)									
CP Mode											
Range		0-25.02-250.2W		0-35.04-350.4W		0-35.04-350.4W		0-70.02-700.2W		0-70.02-700.2W	
		(Imax=r1:5A, r2:50A)		(Imax=r1:7A, r2:70A)		(Imax=r1:1.5A, r2:15A)		(Imax=r1:14A, r2:140A)		(Imax=r1:3A, r2:30A)	
Resolution		0.417mW/4.17mW		0.584mW/5.84mW		0.584mW/5.84mW		1.167mW/11.67mW		1.17mW/117mW	
Accuracy		±0.5% of (SETTING + RANGE)									
Dynamic Mode											
THIGH/TLOW		10μS to 9.999 Sec									
Resolution		0.001/0.01/0.1/1mS									
Slew rate	L	0.032-2A/μs		0.0464-2.90A/μs		1-62.5mA/μs		0.0096-0.6A/μs		2-125mA/μs	
	H	3.2-200mA/μs		4.64-290mA/μs		10-625mA/μs		0.096-6A/μs		20-1250mA/μs	
Accuracy		±5%±10μs									
Measurement											
Voltage Read Back	Range (5 Digital)	0-8.1-81V		0-8.1-81V		0-60-500V		0-8.1-81V		0-60-500V	
	Resolution	0.135mV/1.35mV		0.135mV/1.35mV		1mV/10mV		0.135mV/1.35mV		1mV/10mV	
	Accuracy	±0.025% of (READING+ RANGE)									
Current Read Back	Range (5 Digital)	0-5.04-50.4A		0-7.02-70.2A		0-1.5-15A		0-14.04-140.4A		0-3-30A	
	Resolution	0.084mA/0.84mA		0.117mA/1.17mA		0.025mA/0.25mA		0.234mA/2.34mA		0.05mA/ 0.5mA	
	Accuracy	±0.1% of (READING+ RANGE)									
Power Read Back	Range (5 Digital)	25W	250W	35W	350W	35W	350W	70W	700W	70W	700W
	Resolution	0.001W	0.01W	0.001W	0.01W	0.001W	0.01W	0.001W	0.01W	0.001W	0.01W
	Accuracy	±0.1% of (READING+ RANGE)									
Surge Test											
Surge & Normal current		0-50A		0-70A		0-15A		0-140A		0-30A	
Surge time		10-1000ms		10-1000ms		10-1000ms		10-1000ms		10-1000ms	
Surge step		1-5		1-5		1-5		1-5		1-5	
Battery Discharge Test											
UVP		0-81V		0-81V		0-500V		0-81V		0-500V	
Time		1-99999 Sec		1-99999 Sec		1-99999 Sec		1-99999 Sec		1-99999 Sec	
Capacity		0.1-19999.9AH/0.1-19999.9WH									
Others											
Load ON Voltage		0.1-25V				0.4-100V		0.1-25V		0.4-100V	
Accuracy		1% of (SETTING + RANGE)									
Load OFF Voltage		0-25V				0-100V		0-25V		0-100V	
Accuracy		0.05% of (SETTING + RANGE)									
Imonitor (Non-isolated)		5.04 A/V		7.02 A/V		1.5 A/V		14.04 A/V		3 A/V	
Current Monitor		Full scale: 10V									
Accuracy		0.5% of (SETTING + RANGE)									
Typical Short Resistance		0.018Ω		0.0169Ω		0.367Ω		0.0053Ω		0.087Ω	
Max. short Current		50A		70A		15A		140A		30A	
Power input		115/230 Vac±10%, 50/60Hz									
Interface (Standard)		USB/RS232									
Power Consumption		40 VA						60 VA			
Dimension (HxWxD)		205 x 123 x 477mm		205 x 123 x 477mm		205 x 123 x 477mm		205 x 231 x 480mm		205 x 231 x 480mm	
Weight		5.3kg		5.3kg		5.3kg		10.3kg		10.3kg	

DIMENSIONS



PEL-507-80-140 / PEL-507-500-30





UTS3000T+ Series Spectrum Analyzer

Datasheet

This document applies to the following models:
UTS3015T+, UTS3032T+

V 1.1

June 2025

Product Features

- Frequency measurement range: 9 kHz to 1.5 GHz, 9 kHz to 3.2 GHz
- Display average noise level (DANL) can be as low as -161 dBm (Typical value)
- Phase noise < -98 dBc/Hz (Offset 10 kHz, typical value)
- Full amplitude Precision < 0.7 dB
- Up to 10,001 scanning points
- Minimum resolution bandwidth (RBW) 1 Hz
- Advanced function one key measurement (Option)
- EMI Pre-compliance analysis function (Option)
- Supports analog demodulation analysis (Option)
- Supports tracking generator output function
- 10.1-inch 1280 × 800 HD capacitive touch screen
- Provides USB/LAN interface, supports SCPI protocol

Multi-touch HD Screen for Quick Operation

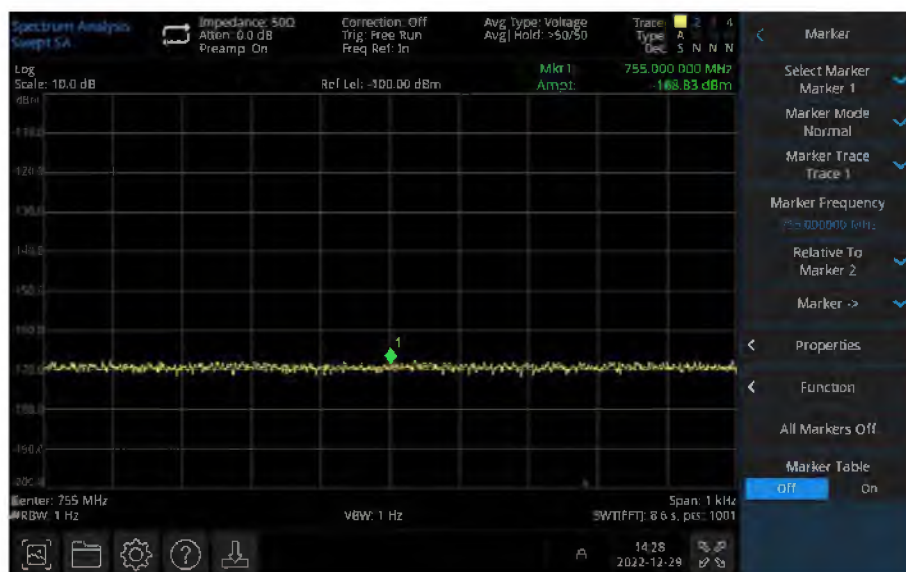
10.1-inch multi-touch HD capacitive screen with quick menu settings. Supports multiple gesture operations such as dragging, expanding, and zooming on the trace. Convenient human-computer interaction operation solves the problem of cumbersome and difficult operation to the greatest extent.



Excellent Sensitivity to Test Weaker Signals

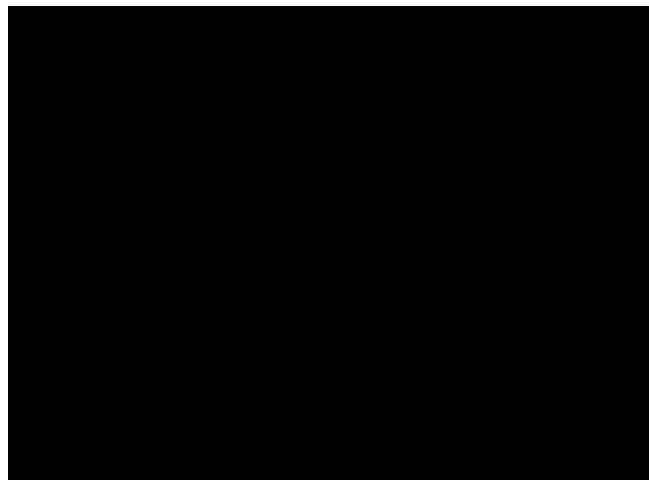
The weak signal test is easily affected by the noise floor of the spectrum analyzer itself.

UTS3000T+ series has a DANL as low as -161 dBm, providing excellent sensitivity to effectively test weak signals.



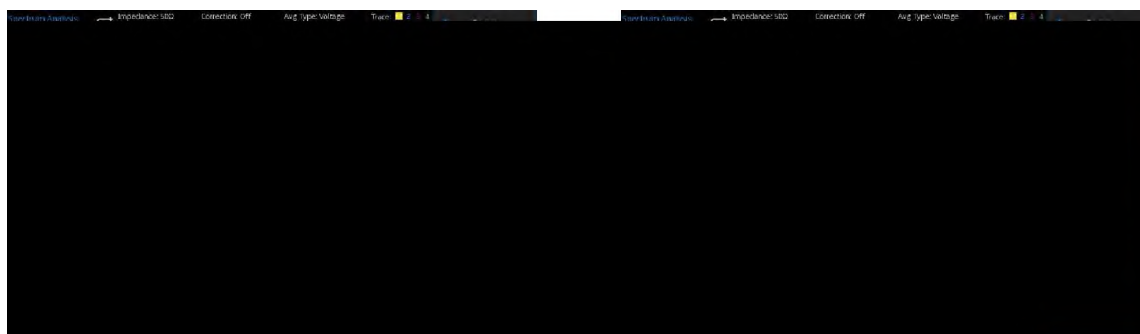
Removable Dust Mesh

With a detachable dust filter, after the instrument is used for a period of time, the user can remove the dust from the air inlet. To ensure the reliability of the whole machine, it can avoid short-circuit, burn or fire caused by dust.



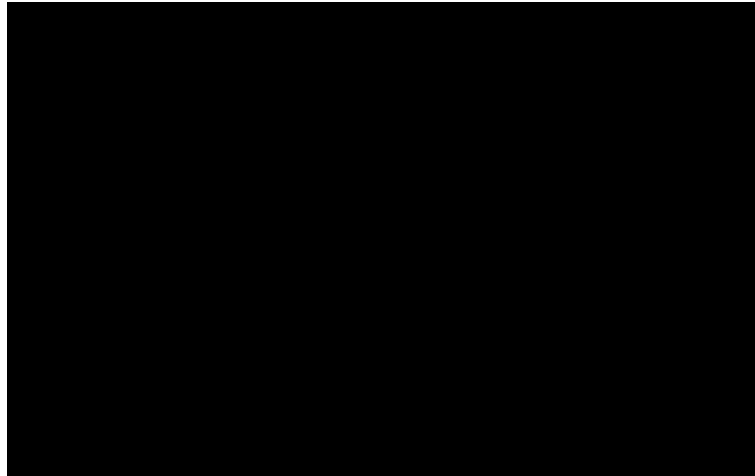
Scan 10,001 points

UTS3000T+ series provides up to 10,001 sweep points, offering higher frequency resolution and making it easier to capture signals that are difficult to detect.



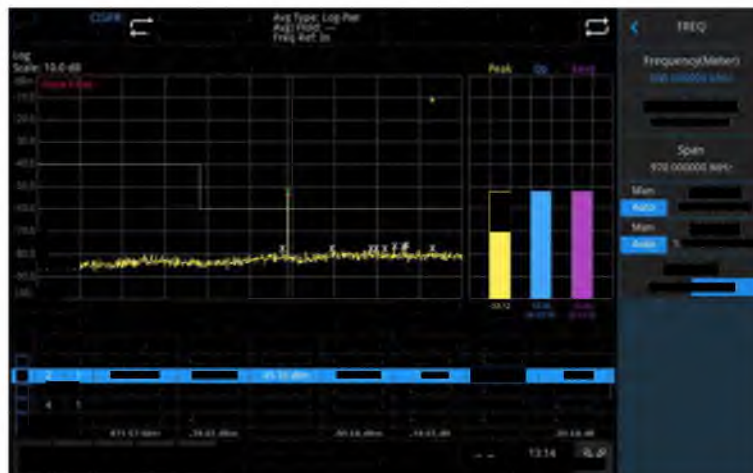
Excellent Selectivity

It has a stronger capability to resolve signals of adjacent unequal amplitudes.



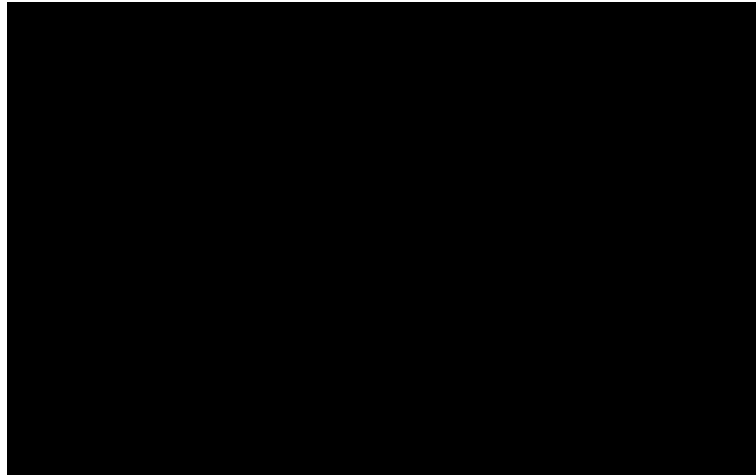
EMI pre-compliance (Option)

UTS3000T+ series includes optional components that, when used with near-field probes, assist in locating and resolving EMI defects in advance, thereby shortening the development cycle.



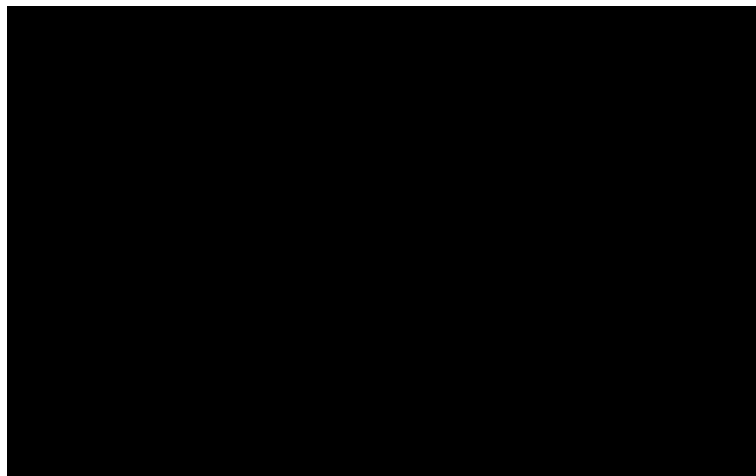
Advanced measurement (Option)

The advanced measurement mode provides the test items required by the transmitter test specification: Channel Power, T-power, Occupied BW, TOI, ACP, Spectrum Monitor, CNR, and Harmonics.



Analog demodulation analysis (Option)

Provides AM, FM analog signal for demodulation analysis



Definitions and Conditions

"Specifications" describes the performance of the parameters covered by the product warranty in detail, unless otherwise noted, these specifications apply to the temperature range of 20°C to 30°C.

"Typical" refers to other product performance information not covered by the product warranty. 80% of the units can exhibit 95% confidence over the temperature range of 20 °C to 30 °C when performance is out of specification. Typical performance does not include measurement uncertainty.

"Nominal Value" means expected performance, or describes product performance that is useful in product applications but not covered by the product warranty.

The analyzer can meet its specifications under the following conditions:

It is within its calibration cycle and has warmed up for at least 30 minutes.

If the analyzer has been stored within the allowable storage temperature range but outside the allowable operating temperature range, it must be placed within the allowable operating temperature range for at least two hours before starting.

Product Function and Model Comparison Table

	UTS3015T+	UTS3032T+
Spectrum analysis	●	●
EMI	○	○
Analog demodulation	○	○
Advanced measurement	○	○
Tracking generator	●	●
Reflection measurement	●	●

Note: ● Standard ○ Option × Not supported

Frequency and Time Specifications

Frequency

Model	UTS3015T+	UTS3032T+
Frequency range	9 kHz to 1.5 GHz	9 kHz to 3.2 GHz
Resolution bandwidth	1 Hz	

10 MHz internal frequency reference

Frequency reference	10.000000 MHz		
Precision	± [(time since last adjustment x aging rate) + temperature stability +calibration Precision]		
Achievable initial calibration Precision	< 1 ppm		
Temperature stability	< 1 ppm	5 to +45 °C, take 25 °C as reference	
Aging rate	≤ ±1.0 ppm/ year		

Frequency readout Precision (start, stop, center, marker)

Marker resolution	Span / (Sweep point-1)
Marker frequency uncertainty	$\pm (Marker\ frequency \times Frequency\ reference\ Precision + 1\ \% \times Span + 10\ \% \times RBW + Marker\ resolution)$
Marker Mode	Normal, Delta Δ , Fixed
Marker function	Marker Noise, Band Power, Band Density, N dB, Counter
Counter resolution	1 Hz
Uncertainty of frequency counter	$\pm [Marker\ frequency \times Frequency\ reference\ precision + Counter\ resolution]$

Frequency span (FFT and swept mode)

Sweep range	0 Hz, 100 Hz to 1.5 GHz	0 Hz, 100 Hz to 3.2 GHz
Sweep Precision	Swept	$\pm [0.25\% \times Span + Span / (Points-1)]$
	FFT	$\pm [0.10\% \times Span + Span / (Points-1)]$

Sweep time and triggering

Sweep time	1 ms to 4,000 s (span $\neq$ 0)
	1 μ s to 4,000 s (span = 0)
Sweep Type Rule	Precision, Normal
Sweep Mode	Swept (1 kHz to 1 MHz), FFT (1 Hz to 30 kHz)
Sweep Rules	Single, Continuous
Trigger Type	Free Run, External, Video
External trigger input	TTL, Rising/Falling

Resolution bandwidth (RBW)

Range (-3dB bandwidth)	1 Hz to 1 MHz, 1-3-10 steps	
Selectivity (-60 dB/-3 dB)	< 4.8: 1 (Nominal)	-60 dB: -3 dB
Bandwidth Precision (-3dB)	< 5 % (Nominal)	
Video bandwidth (VBW)		
Range	1 Hz to 1 MHz,1-3-10 steps	
Uncertainty of video bandwidth	< 5%	

Amplitude Precision and Range Specifications

Amplitude range		
range	10 MHz to maximum frequency: (DANL) to +30 dBm	
Reference level	-100 dBm to+30 dBm, steps 1 dB	
Preamp	20 dB, Nominal, 9 kHz to 1.5 GHz (3.2 GHz)	
Input attenuator range	0 to 51 dB, 1 dB Step	
Maximum safe input level		
DC volts	50 V DC	max
Maximum continuous wave RF power	≤ +33 dBm	3 minutes, Input attenuation > 20 dB
Display range		
Log scale	1 dB to 200 dB	
Linear scale	0 to Reference level	
Scale units	dBm, dBmV, dBμV, V, W	
Sweep (trace) point range	10,001	
Number of traces	4	
Detector	Sample, Peak, Negative, Normal, Average	
Trace Type	Clear/Write, Average, Max Hold, Min Hold	
Frequency response		
20°C to 30°C, 30% to 70% relative humidity, Input attenuation 20 dB, be relative to 50 MHz.		
Preamp Off	9 kHz to 3.2 GHz	±0.6 dB; ± 0.3 dB, Typical
Preamp On	100 kHz to 3.2 GHz	±1.0 dB; ± 0.8 dB, Typical
Error and precision		
Resolution bandwidth switching uncertainty	Relative to 10 kHz RBW logarithmic resolution ± 0.2 dB, linear resolution ± 0.01, Nominal	
Input attenuation switching uncertainty	20 to 30 °C, fc=50 MHz, Preamp Off, Relative to 20 dB attenuation, Input attenuation 1 to 51 dB ± 0.5 dB	

Absolute amplitude Precision	20 to 30 °C, $f_c=50$ MHz, RBW=1 kHz, VBW=1 kHz, Peak detectors, Input attenuation 20 dB	
	± 0.4 dB, Input signal level -20 dBm, Preamp Off	
	± 0.5 dB, Input signal level -40 dBm, Preamp On	
Total absolute amplitude Precision	20 to 30 °C, $f_c > 100$ kHz, Input signal level -50 dBm to 0 dBm, RBW = 1 kHz, VBW = 1 kHz, Peak detectors, Input attenuation 20 dB, Preamp Off, 95% confidence	
	$\pm (0.4 \text{ dB} + \text{Frequency response})$	
Input voltage standing wave ratio (VSWR)	1 MHz to 1.5 GHz	1 MHz to 3.2 GHz
	≤ 1.8 (Nominal)	$\leq .8$ (Nominal)

Dynamic Range Specifications

1 dB gain compression

20 to 30 °C, $f_c \geq 50$ MHz, Input attenuation 0 dB, Preamp off
 > -5 dBm, Nominal

Displayed average noise level (DANL)

20 to 30 °C, 0dB RF attenuation, RBW=1 Hz, VBW=1 Hz, sample detector, average > 50

		UTS3015T+	UTS3032T+
Preamp off	9 kHz to 500 kHz	-130 dBm (Nominal)	-105 dBm (Nominal)
	500 kHz to 1 MHz	-143 dBm, -145 dBm (Typical)	-115 dBm, -120 dBm (Typical)
	1 MHz to 10 MHz	-142 dBm, -144 dBm (Typical)	-127 dBm, -130 dBm (Typical)
	10 MHz to 200 MHz	-142 dBm, -143 dBm (Typical)	-142 dBm, -145 dBm (Typical)
	200 MHz to 1.5 GHz	-140 dBm, -142 dBm (Typical)	-143 dBm, -146 dBm (Typical)
	1.5 GHz to 3.2 GHz	---	-140dBm, -143dBm (Typical)
Preamp on	9 kHz to 500 kHz	-145 dBm (Nominal)	-125 dBm (Nominal)
	500 kHz to 1 MHz	-155 dBm, -157 dBm (Typical)	-130 dBm, -135 dBm (Typical)
	1 MHz to 10 MHz	-155 dBm, -158 dBm (Typical)	-145 dBm, -147 dBm (Typical)
	10 MHz to 200 MHz	-158 dBm, -160 dBm (Typical)	-158 dBm, -160 dBm (Typical)
	200 MHz to 1.5 GHz	-159 dBm, -161 dBm (Typical)	-161 dBm, -164 dBm (Typical)
	1.5 GHz to 3.2 GHz	---	-159 dBm, -161 dBm (Typical)

Spurious responses

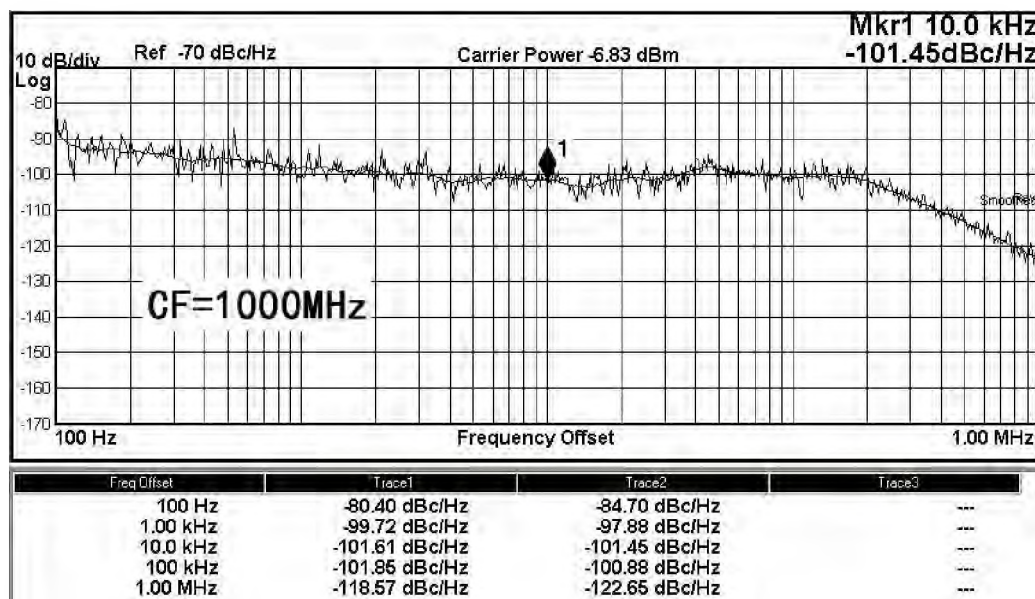
Second harmonic distortion (SHI) 20 to 30 °C, Preamp off, Signal input -30 dBm, 0dB RF

	attenuation	
	$f_c \geq 50$ MHz	-65 dBc/+35 dBm
Third-order intermodulation distortion (TOI)	20 to 30 °C, Preamp off, Signal input-20 dBm, 0 dB RF attenuation, $f_c \geq 50$ MHz	
	+10 dBm; +13 dBm Nominal	
Input related spurious	20 to 30 °C, Mixer level: -30 dBm	
	< -60 dBc	
Residual responses	20 to 30 °C, Input port 50 Ω , RF attenuation 0 dB	
	< -90 dBm	

Phase noise

20 to 30 °C, $f_c = 1$ GHz, RBW=1 kHz, VBW=10 Hz, Sampling detection, Log avg, avg> 50

Offset	UTS3015T+	UTS3032T+
10 kHz	-95 dBc/Hz, -98 dBc/Hz (Typical)	-95 dBc/Hz, -98 dBc/Hz (Typical)
100 kHz	-96 dBc/Hz, -98 dBc/Hz (Typical)	-93 dBc/Hz, -98 dBc/Hz (Typical)
1 MHz	-115 dBc/Hz, -120 dBc/Hz (Typical)	-115 dBc/Hz, -120 dBc/Hz (Typical)



Tracking Generator Specifications

Frequency

Frequency range	100 kHz to 1.5 GHz	10 MHz to 3.2 GHz
Counter resolution	10 Hz	

Output power level

Range	-40 dBm to 0 dBm
Resolution	0.5 dB
Flatness output	be relative to 50 MHz ± 3 dB
Maximum safe reverse input level	
Average total power	30 dBm
AC coupling	±50 VDC

Analog Demodulation Analysis (Option)

Demodulation		
Frequency range	2 MHz to 1.5 GHz	2 MHz to 3.2 GHz
Carrier power Precision	± 2 dB	
Input power	-30 dB to +20 dBm	Automatic attenuation
Carrier power display resolution	0.01 dBm	
AM measurement		
Modulation rate	20 Hz to 100 kHz	
Precision	1 Hz (Nominal) < 0.1% Modulation rate (Nominal)	Modulation rate < 1 kHz Modulation rate ≥ 1 kHz
Depth	5 to 95%	
Precision	± 4% (Nominal)	
FM measurement		
Modulation rate	20 Hz to 100 kHz	
Precision	1 Hz (Nominal) < 0.1% Modulation rate (Nominal)	Modulation rate < 1 kHz Modulation rate ≥ 1 kHz
Frequency offset	1 kHz to 400 kHz	
Precision	± 4% (Nominal)	

EMI (Option)

EMI Resolution bandwidth	
Resolution bandwidth (-6dB)	200 Hz, 9 kHz, 120 kHz, 1 MHz
Resolution bandwidth Precision	< 5%, (Nominal)

EMI detector

EMI detector	Peak, Negative Peak, Quasi Peak, EMI Average, Average
--------------	---

EMI Main function

Main function	EMI Standard: CISPR
	View: Scan table, Meter, Signal table
	Meter control
	Avg settings
	Limit: AS-NZS, BellCore, DEF-STAN, DO-160, EN, FCC, GB9254, MIL-461, VCCI and Custom
	Signal table settings
	Scan table settings
	Scan Sequence: Scan, Search, Scan-Search-Meas, Scan-Search, Search-Meas, Measure
	Sig Detector
	Output report

Reflection measurement

Incentive and reflex measurement

Cursor measurement	VSWR, Return loss, Reflection coefficient
Calibration type	Open
Excitation power	-20 to 0 dBm

Advanced measurement kit (Option)

Power Measurement

Channel power	Channel power, Power spectral density
ACP (Adjacent Channel Power)	Main CH Power, Left channel power, Right channel power
Occupied bandwidth	Occupied Bandwidth, Transmit Frequency Error
Time domain power	Zero Span Integrated Power
CNR (Carrier Noise Ratio)	C/N, Noise Power

Non-Linear Measurement

TOI, Third-order intercept	Measure the third-order products from two tones
Harmonic measurement	Max Harmonic number 10

Spectrum Monitor Measurement

Spectrogram

Interface and display

Common interface

RF input	Type-N female, 50 Ω , nominal
Front panel trace source output	Type-N female, 50 Ω , nominal
10 MHz Ext Ref In	10 MHz, > 0 dBm, BNC female, 50 Ω , nominal
10 MHz out	10 MHz, -5 dBm to +10 dBm, BNC female, 50 Ω , nominal
External trigger input	TTL, BNC female
HDMI display	HDMI 1.4 display interface
USB-Host	USB-A
USB-Device	USB-B
LAN	LAN (VXI11), 10/100/1,000 Base, RJ-45
Headphone Jack	3.5 mm (1/8 inch) miniature stereo audio jack

Display screen

Display type	10.1-inch capacitive multi-touch panel
Display resolution	1280×800, RGB Vertical pixel

General Technical Specifications

Specifications

Supply voltage	100 to 240 VAC (Fluctuations $\pm 10\%$)	100 to 120 VAC (Fluctuations $\pm 10\%$)
Frequency	50/60 Hz	400 Hz

Environment

Temperature range	operation: 0°C to +40°C Non-operating: -20°C to +70°C
Cooling method	Fan forced cooling
Humidity range	Operation: Below + 35 °C $\leq$ 90% relative humidity; Non-operating: + 35 °C to +40 °C $\leq$ 60% relative humidity
Altitude	Operation: Below 3,000 m; Non-operating: Below 15,000 m
Pollution degree	2
Operating environment	Indoor use

Mechanical specifications

Dimensions	378mm×218mm×120mm (Width x Height x Length)
Net weight	4.55 kg
Calibration period	The recommended calibration period is one year

Regulatory standards

EMC	Compliance with EMC directives(2014/30/EU), Conform to or better than IEC 61326-1:2021/EN61326-1:2021, IEC 61326-2-1:2021/EN61326-2-1:2021	
Conductive disturbance	CISPR 11/EN 55011	CLASS B group 1, 150kHz-30MHz
Radiation disturbance	CISPR 11/EN 55011	CLASS B group 1, 30MHz-1GHz
(ESD)Electrostatic discharge (ESD)	IEC 61000-4-2/EN 61000-4-2	±4.0 kV (Contact), ±8.0 kV (air)
Radio frequency electromagnetic field immunity	IEC 61000-4-3/EN 61000-4-3	3 V/m (80 MHz to 1 GHz) ; 0 V/m (1.4 GHz to 6 GHz)
(EFT)Electrical fast transient burst (EFT)	IEC 61000-4-4/EN 61000-4-4	±1 kV (AC input port)
Surge	IEC 61000-4-5/EN 61000-4-5	±0.5 kV (Live line to zero line) ±1 kV (Fire/zero line to ground)
Immunity to RF continuous conduction	IEC 61000-4-6/EN 61000-4-6	3 V, 0.15-80 MHz
Voltage dips and short interruptions	IEC 61000-4-11/EN 61000-4-11	Voltage dip: 0% UT during 0.5 cycle; 0% UT during 1 cycle; 70% UT during 25/30 cycles Short Interruption: 0% UT during 250/300 cycles

Safety regulations

EN 61010-1:2010+A1:2019
 EN IEC61010-2-030:2021+A11:2021
 UL 61010-1:2012 Ed.3+ R:19 Jul2019
 UL 61010-2-030:2018 Ed.2
 CSA C22.2#61010-1:2012 Ed.3+U1;U2;A1
 CSA C22.2#61010-2-030:2018 Ed.2

Order Information

	Description	Order No.
Model	Spectrum analyzer, 9 kHz to 1.5 GHz	UTS3015T+
	Spectrum analyzer, 9 kHz to 3.2 GHz	UTS3032T+
Standard	Power cord ×1	
accessories	USB cable x1	UT-D14

Recommended options & accessories		
Options	Advanced measurement kit	UTS3000-AMK
	EMI measurement option	UTS3000-EMI
	Analog demodulation analysis option	UTS3000-AMA
UT-CK01 accessories kit	SMAJ-NJ-0.7M DC-6G cable x1	UT-W02-6GHz
	NJ-NJ-0.7M DC-6G cable x1	UT-W01-6GHz
	Adapter SMA-N-KJ-T DC-6GHz x2	UT-C01-6GHz
	Adapter N-BNC-JK DC-4GHz x2	UT-C02-4GHz
	Antenna 2400 MHz-2500 MHz x2	UTS-T01
	Antenna 824-960 MHz/1710-1990 MHz x2	UTS-T02
UTS-EMI01 Near-field probes kit	50Ω-SMA-SMB cable x1	UT-W03
	Adapter SMA-N-KJ-T DC-6 GHz x1	UT-C01
	Near field probe, frequency range 30 MHz-3 GHz, Detection range 10 cm x1	NFP-3G-P1
	Near field probe, frequency range 30 MHz-3 GHz, Detection range 3 cm x1	NFP-3G-P2
	Near field probe, frequency range 30 MHz-2 GHz, resolving power 5 mm x1	NFP-2G-P3
	Near field probe, frequency range 30 MHz-3 GHz, resolving power 2 mm x1	NFP-3G-P4
Reflection Measurement	VSWR bridge	UT-RB60

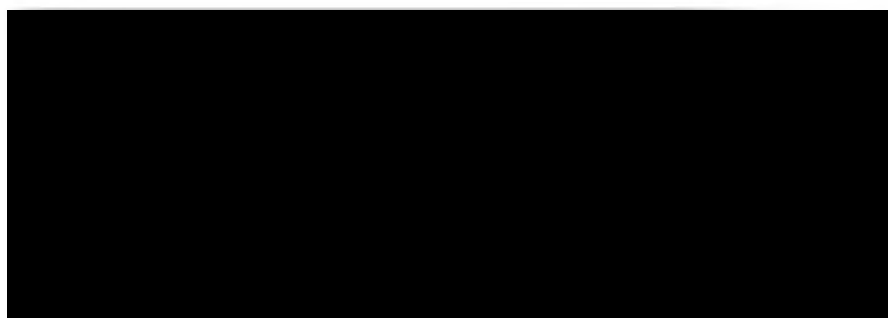
Options ordering and installation

1. **Purchase options:** Based on your requirements, please purchase the specified function options from Uni-t Sales Personnel and provide the serial number of the instrument that needs the option installed.
2. **Receive certificate:** You will receive the license certificate based on the address provided in the order.
3. **Register and obtain license:** Visit the Uni-t official website license activation session for registration. Use the license key and instrument serial number provided in the certificate to obtain the option license code and license file.
4. **Install the option:** Download the option license file to the root directory of a USB storage device, and connect the USB storage device to the instrument. Once the USB storage device is recognized, the Option Install menu will be activated. Press this menu key to begin installing the option.

Limited Warranty and Liability

UNI-T guarantees that the Instrument product is free from any defect in material and workmanship within three years from the purchase date. This warranty does not apply to damages caused by accident, negligence, misuse, modification, contamination, or improper handling. If you need a warranty service within the warranty period, please contact your seller directly. UNI-T will not be responsible for any special, indirect, incidental, or subsequent damage or loss caused by using this device. For the probes and accessories, the warranty period is one year. Visit

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U1230 Series

Handheld Digital Multimeters (DMMs)

Introduction

Retool your expectations with the new Keysight Technologies, Inc. U1230 Series Handheld DMMs — the first to combine a built-in LED flashlight, both audible and visual alerts, and non-contact AC voltage detection in one handheld.

Whether it is dark, noisy, or even dangerous, the U1230 Series handheld digital multimeters keep you equipped with features that anticipate worst-case scenarios. The ergonomically shaped handheld allows you to single-handedly illuminate the test area with a built-in flashlight while selecting the rotary dial's measurement functions. Vsense performs non-contact voltage detection while continuity detection is made easy with the audible beeper alert and flashing backlight display. With the U1230 Series, you work better in the conditions wherever you are.



Key features

- Built-in LED flashlight to illuminate test area
- Flashing backlight as additional visual alert during
- continuity tests in noisy environments
- Vsense to perform non-contact voltage detection
- Data logging capability (stores up to 10 readings)
- IR-to-USB connectivity to transfer data to PC for record

Ergonomically shaped with a built-in flashlight

Built for handheld users working in a poorly lit environment, the U1230 Series allows you to single-handedly illuminate your test area while making measurements with its easily activated built-in flashlight. Its ergonomic shape fits your hand, while the easily accessible rotary dial allows the selection of measurement functions.

Flashing backlight and beeping alert for continuity detection

The U1230 Series is built for continuity detection in dark and noisy environments. Its audible beep and flashing backlight display provide increased visual and audio alerts to indicate continuity.

Non-contact voltage detection with Vsense

Vsense is a unique feature found in the U1233A model that performs non-contact voltage detection. It delivers more safety while making measurements in dangerous working environments by avoiding contact with hot or live wires. Upon detecting voltage, it produces a unique combination of beeping alert and blinking LED light to make measurements more efficient – especially in a dark or noisy environment.

Take a Close

Bar graph indication
frequency measurement

Freezes and stores current
measurement

Low input impedance
eliminate ghost voltage
measure

Anti-slip rotary dial
easy measurement
function selection

Warning light and audible
beep during presence of
high voltage ¹

Low flexibility to change
measurement range

Device performs non-
contact voltage detection¹

Easy viewing with display
Backlight or built-in
flashlight

Figure 1. U1230 Series front view



Figure 2. The built-in flashlight as illustrated

Overview of Keysight U1230 Series Handheld Digital Multimeters

Key specifications	U1231A	U1232A	U1233A
Display resolutions	6000	6000	6000
Basic DCV accuracy	0.5% + 2 counts	0.5% + 2 counts	0.5% + 2 counts
Auto/manual ranging	Yes	Yes	Yes
Measurement			
DCV	600 mV to 600 V	600 mV to 600 V	600 mV to 600 V
ACV (RMS)	600 mV to 600 V	600 mV to 600 V	600 mV to 600 V
DCI	No	60 μ A to 10 A	60 μ A to 10 A
ACI	No	60 μ A to 10 A	60 μ A to 10 A
Resistance	600 Ω to 60 M Ω	600 Ω to 60 M Ω	600 Ω to 60 M Ω
Frequency	99.99 Hz to 99.99 kHz	99.99 Hz to 99.99 kHz	99.99 Hz to 99.99 kHz
Continuity, diode test	Yes	Yes	Yes
Capacitance	1000nF to 10mF	1000nF to 10mF	1000nF to 10mF
Temperature	No	No	40 to 1372 $^{\circ}$ C
Vsense for non-contact voltage detection	No	No	Yes
Z _{Low} - low impedance mode	Yes	Yes	Yes
Internal memory for data logging	Yes (10 readings only)	Yes (10 readings only)	Yes (10 readings only)
General			
Built-in flashlight	Yes	Yes	Yes
IP rating	IP 42	IP 42	IP 42
Over-voltage safety protection	CAT III 600V	CAT III 600V	CAT III 600V
Battery life	500 hours	500 hours	500 hours
Warranty	3 years	3 years	3 years

Overview of Keysight U1230 Series Handheld Digital Multimeters

Key specifications	U1231A	U1232A	U1233A
Display resolutions	6000	6000	6000
Basic DCV accuracy	0.5% + 2 counts	0.5% + 2 counts	0.5% + 2 counts
Auto/manual ranging	Yes	Yes	Yes
Measurement			
DCV	600 mV to 600 V	600 mV to 600 V	600 mV to 600 V
ACV (RMS)	600 mV to 600 V	600 mV to 600 V	600 mV to 600 V
DCI	No	60 μ A to 10 A	60 μ A to 10 A
ACI	No	60 μ A to 10 A	60 μ A to 10 A
Resistance	600 Ω to 60 M Ω	600 Ω to 60 M Ω	600 Ω to 60 M Ω
Frequency	99.99 Hz to 99.99 kHz	99.99 Hz to 99.99 kHz	99.99 Hz to 99.99 kHz
Continuity, diode test	Yes	Yes	Yes
Capacitance	1000nF to 10mF	1000nF to 10mF	1000nF to 10mF
Temperature	No	No	40 to 1372 $^{\circ}$ C
Vsense for non-contact voltage detection	No	No	Yes
Z _{Low} - low impedance mode	Yes	Yes	Yes
Internal memory for data logging	Yes (10 readings only)	Yes (10 readings only)	Yes (10 readings only)
General			
Built-in flashlight	Yes	Yes	Yes
IP rating	IP 42	IP 42	IP 42
Over-voltage safety protection	CAT III 600V	CAT III 600V	CAT III 600V
Battery life	500 hours	500 hours	500 hours
Warranty	3 years	3 years	3 years

Electrical Specifications

DC specifications

Function	Range	Resolution	Accuracy ± (% of reading + counts of least significant digit)	Test current	Burden voltage/shunt	Nominal input impedance
			U1231A / U1232A / U1233A	Where (applicable)	Where (applicable)	Where (applicable)
Voltage						
	600 mV ¹	0.1 mV	0.5% + 2	NA	NA	11.18 MΩ
	6 V	0.001 V	0.5% + 2	NA	NA	11.18 MΩ
	60 V	0.01 V	0.5% + 2	NA	NA	10.1 MΩ
	600 V	0.1 V	0.5% + 2	NA	NA	10 MΩ
	600 V (VZ _{Low}) ²	0.1 V	2% + 3	NA	NA	3 kΩ
Resistance						
	600 Ω ⁴	0.1 Ω	0.9% + 3	0.57 mA	NA	NA
	6 kΩ ⁴	0.001 kΩ	0.9% + 3	57 μA	NA	NA
	60 kΩ	0.01 kΩ	0.9% + 3	5.7 μA	NA	NA
	600 kΩ	0.1 kΩ	0.9% + 3	570 nA	NA	NA
	6 MΩ ⁵	0.001 MΩ	0.9% + 3	100 nA/10 MΩ	NA	NA
	60 MΩ ⁵	0.01 MΩ	1.5% + 3	100 nA/10 MΩ	NA	NA
Diode³						
	2 V	0.001 V	0.9% + 2	0.57 mA	NA	NA
Current⁴						
	60 μA ¹	0.01 μA	1.0% + 2	NA	< 2.5 V/1 kΩ	NA
	600 μA ¹	0.1 μA	1.0% + 2	NA	< 2.5 V/1 kΩ	NA
	6 A ^{2,5}	0.001 A	1.0% + 3	NA	< 0.2 V/0.005 Ω	NA
	10 A ^{2,3}	0.01 A	1.0% + 3	NA	< 0.4 V/0.005 Ω	NA

Notes for DC voltage specifications:

1. The accuracy of the 600-mV range is specified after the Null function is used to subtract the thermal effect (by shorting the test leads).
2. For VZ_{Low} (low input impedance) measurements, auto-ranging is disabled, and the multimeter's range is set to 600 V in the manual ranging mode.

Notes for resistance specifications:

1. Overload protection: 600 Vrms for short circuits with < 0.3 A current.
2. The maximum open voltage is < +3 V.
3. Built-in buzzer beeps when the resistance measured is less than 23 Ω ± 10 Ω. The multimeter can capture intermittent measurements longer than 1 ms.
4. The accuracy of the 600 Ω to 6 kΩ range is specified after the Null function is used to subtract the test lead resistance and thermal effect (by shorting the test leads).
5. For the ranges of 6 MΩ and 60 MΩ, the RH is specified for < 60%.

Notes for diode specifications:

1. Overload protection: 600 Vrms for short circuits with < 0.3 A current.
2. Built-in buzzer beeps continuously when the voltage measured is less than 50 mV and beeps once for forward-biased diode or semiconductor junctions measured between 0.3 V and 0.8 V (0.3 V ≤ reading ≤ 0.8 V).
3. Open voltage for diode: < +3 V DC.
4. The maximum display for diode measurements is 2100 counts.

Notes for DC current specifications:

1. Overload protection for 60 μA to 600 μA range: 600 Vrms for short circuits with < 0.3 A current.
2. Overload protection for 6 A to 10 A range: 11 A/1000 V; 10 × 38 mm fast-acting fuse.
3. Specification for 10 A range: 10 A continuous. Add 0.3% to the specified accuracy when measuring signals > 10 A to 20 A for 30 seconds maximum. After measuring currents > 10 A, cool down the multimeter for twice the measured time duration before proceeding with low current measurements.
4. Only applicable for the U1232A/U1233A model.
5. DC current between ± (0.6 mA and 1 mA) is not measurable on the U1232A and U1233A models. Low DC current measurement is restricted by resolution and accuracy specification.

AC specifications

True rms AC voltage and AC current specifications

Function	Range	Resolution	Accuracy $\pm$ (% of reading + counts of least significant digit)		Burden voltage/shunt
			45 Hz to 500 Hz	500 Hz to 1 kHz	Where (applicable)
Voltage	600 mV	0.1 mV	1.0% + 3	2.0% + 3	NA
	6 V	0.001 V	1.0% + 3	2.0% + 3	NA
	60 V	0.01 V	1.0% + 3	2.0% + 3	NA
	600 V	0.1 V	1.0% + 3	2.0% + 3	NA
	600 (VZ _{LOW}) ³	0.1 V	2.0% + 3	4.0% + 3	NA
Current ¹	60 μ A ²	0.01 μ A	1.5% + 3	NA	< 2.5 V/1 k Ω
	600 μ A ²	0.1 μ A	1.5% + 3	NA	< 2.5 V/1 k Ω
	6 A ^{3,5}	0.001 A	1.5% + 3	NA	< 0.2 V/0.005 Ω
	10 A ^{3,4}	0.01 A	1.5% + 3	NA	< 0.4 V/0.005 Ω

Notes for true rms ac voltage specifications:

1. Overload protection: 600 Vrms. For millivolt measurements, 600 Vrms for short circuits with < 0.3 A current.
2. Input impedance: 10 M Ω (nominal) in parallel with < 100 pF.
3. VZLOW input impedance: 3 k Ω (nominal).

Notes for AC current specifications:

1. AC current measurement is not available for the U1231A model.
2. Overload protection for 60 μ A to 600 μ A range: 600 Vrms for short circuits with < 0.3 A current.
3. Overload protection for 6 A to 10 A range: 11 A/1000 V; 10 $\times$ 38 mm fast-acting fuse.
4. Specification for 10 A range: 10 A continuous. Add 0.3% to the specified accuracy when measuring signals > 10 A to 20 A for 30 seconds maximum. After measuring currents > 10 A, cool down the multimeter for twice the measured time duration before proceeding with low current measurements.
5. AC current between 0.6 mA and 300 mA is not measurable on the U1232A and U1233A models

Capacitance specifications

Range	Resolution	Accuracy $\pm$ (% of reading + counts of least significant digit)	Measuring rate (at full scale)
		U1231A/U1232A/U1233A	
1000 nF	1 nF	1.9% + 2	4 times/second
10 μ F	0.01 μ F	1.9% + 2	4 times/second
100 μ F	0.1 μ F	1.9% + 2	4 times/second
1000 μ F	1 μ F	1.9% + 2	1 time/second
10 mF	0.01 mF	1.9% + 2	0.1 time/second

Notes:

1. Overload protection: 600 Vrms for short circuits with < 0.3 A current.
2. The accuracy for all ranges is specified based on a film capacitor or better, and after the Null function is used to subtract the test lead resistance and thermal effect (by opening the test leads).
3. The maximum display is 1200 counts.

Temperature specifications ¹⁻⁷

Thermal type	Range	Resolution	Accuracy $\pm$ (% of reading + counts of least significant digit)
K	-40 °C to 1372 °C	0.1 °C	U1233A 1% + 1 °C
	-40 °F to 2502 °F	0.1 °F	1% + 1.8 °F

Notes:

1. The specification above is specified after 60 minutes of warm-up time. If the unit is exposed during storage in high humidity (condensing) environment, 120 minutes of operating time are required.
2. The accuracy does not include the tolerance of the thermocouple probe.
3. Do not allow the temperature sensor to contact an energized surface above 30 Vrms or 60 V DC. Such voltages pose a shock hazard.
4. The temperature calculation is specified according to the safety standards of EN/IEC-60548-1 and NIST175.
5. The approximate ambient temperature (cold-junction compensation) is shown on the display when you have an open thermocouple. The open thermocouple message may be due to a broken (open) probe or because no probe is installed into the input jacks of the multimeter.
6. For temperature measurement on U1233A, the type-K thermocouple probe and adapter such as the U1186A (purchase separately) are required.
7. For auxiliary temperature measurement on U1231A & U1232A, a temperature module such as the U1586B (purchase separately) is required.

Frequency specifications

Range	Resolution	Accuracy $\pm$ (% of reading + counts of least significant digit)	Minimum input frequency
		U1231A/U1232A/U1233A	
99.99 Hz	0.01 Hz	0.1% + 2	5 Hz
999.9 Hz	0.1 Hz	0.1% + 2	
9.999 kHz	1 Hz	0.1% + 2	
99.99 kHz	10 Hz	0.1% + 2	

Note:

1. Overload protection: 600 V; input signal is $< 20,000,000 \text{ V} \times \text{Hz}$ (product of voltage and frequency).

Frequency Sensitivity Specifications

For voltage measurements

Input range	Minimum sensitivity (rms sine wave) 5 Hz to 50 kHz		
Maximum input for specified accuracy ¹	U1231A	U1232A	U1233A
600 mV in Scale mode	50 mV	50 mV	50 mV
600 mV	120 mV	120 mV	120 mV
6 V	0.6 V	0.6 V	0.6 V
60 V	5.0 V	5.0 V	5.0 V
600 V	50 V	50 V	50 V

Note:

1. Maximum input for specified accuracy, refer to "AC specifications" on page 106 of the User Guide.

For current measurements

Input range	Minimum sensitivity (rms sine wave) 45 Hz to 5 kHz	
Maximum input for specified accuracy ¹	U1232A	U1233A
60 μ A	30 μ A	30 μ A
600 μ A	30 μ A	30 μ A
6 A	0.5 A	0.5 A
10 A	0.5 A	0.5 A

Note:

1. Maximum input for specified accuracy, refer to "AC specifications" on page 106 of the User Guide.

Scale transfer (mV)

Range	Resolution	Accuracy $\pm$ (% of reading + counts of least significant digit)
U1231A/U1232A/U1233A		
DC 600 mV	0.1 mV	0.5% + 2 ²
AC 600 mV	0.1 mV	1.0 % + 3 @ 45 Hz to 500 Hz
		2.0 % + 3 @ 500 Hz to 1 kHz

Notes:

1. Overload protection: 600 Vrms for short circuits with < 0.3 A current.
2. The accuracy of the DC 600 mV range is specified after the Null function is used to subtract the thermal effect (by shorting the test leads).
3. Input impedance: 10 M Ω (typical).

Display update rate (approximate)

Function	Times/second	
	U1231A	U1232A/U1233A
AC V (V or mV)	5	5
DC V (V or mV)	5	5
AC VDC V (V _{ZLOW})	1	1
Scale transfer (mV)	5	5
Ω	5	5
Diode	5	5
Capacitance	4 (< 100 μ F)	4 (< 100 μ F)
DC A (μ A, mA, or A)	NA	5
AC A (μ A, mA, or A)	NA	5
Frequency	1 (> 10 Hz)	1 (> 10 Hz)

General Specifications

Parameter	U1231A/U1232A/U1233A
Power supply	Battery type
	Battery life
	Low battery indication
Power consumption	
Fuse	
Display	
Flashlight	
Operating environment	
Storage compliance	
Measurement category	
Safety & Electromagnetic (EMC) compatibility	
Temperature coefficient	
Common Mode Rejection Ratio (CMRR)	
Normal Mode Rejection Ratio (NMRR)	
Dimensions (H x W x D)	
Weight	
Warranty	
Calibration cycle	

Notes:

Please take note that for the product, the warranty does not cover:

- Damage from contamination
- Normal wear and tear of mechanical components
- Manuals, fuses, and batteries

Specification assumptions

- Accuracy is given as $\pm$ (% of reading + counts of least significant digit) at $23^\circ\text{C} \pm 5^\circ\text{C}$, with relative humidity less than 80% RH.
- AC V and AC A specifications are AC coupled, true RMS, and valid from 5% of range to 100% of range.
- Crest factor ≤ 3 at full scale and decrease reciprocally for over range as $3 \times \text{Full Scale/Input}$; except for the 600V range, where this range has a crest factor ≤ 2 at full scale and decreases reciprocally for over range as $2 \times \text{Full Scale/Input}$.
- For non-sinusoidal waveforms, add (2% reading + 2% full scale) typical.
- After VZLOW (low input impedance) voltage measurements, wait at least 20 minutes for thermal impact to cool before proceeding with any other measurement

Ordering Information

Recommended accessories

U1174A		Soft carrying case
U1168A		Standard test lead kit
U1171A		Magnetic hanging kit
U1186A		Thermocouple (K-type) and temperature probe adapter Note: For temperature measurement on the U1233A, a type-K thermocouple probe and adapter such as the U1186A (purchased separately) is recommended. It is only compatible with the U1233A.
U1586B		Temperature module Note: For auxiliary temperature measurement on the U1231A and U1232A, a temperature module such as the U1586B (purchased separately) is recommended.

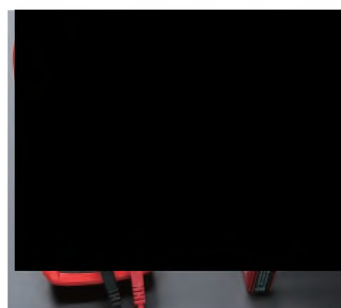
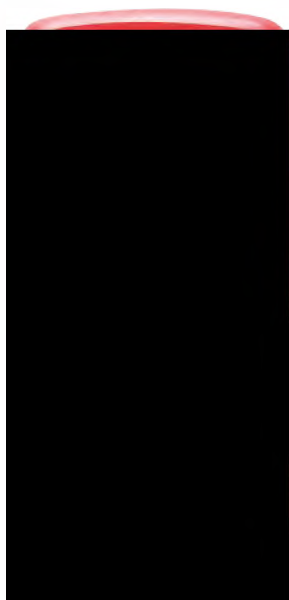
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Intertek



Patent pending



	GOOD	LOW	BAD
1.5V	>1.3V	0.95~1.3V	<0.95V
9V	>7.7V	5.7~7.7V	<5.7V

● Battery status chart

- Over voltage/current audible alarm
- High voltage warning
- Auto power off (can be disabled)
- Low power consumption
- Fast and accurate capacitance measurement
- 2m drop proof

SPECIFICATIONS

	Range	UT133A	UT133B
DC voltage (V)	600mV/6000mV/60V/600V	±(0.5%+3)	±(0.5%+3)
AC voltage (V)	600V	±(0.7%+3)	±(1.2%+3)
DC current (A)	600uA/60mA/600mA/10A	±(1%+3)	±(1%+2)
AC current (A)	10A	±(1.2%+3)	
Resistance (Ω)	600Ω/6000Ω/60kΩ/600kΩ/60MΩ	±(0.8%+2)	±(0.8%+2)
Capacitance (F)	9.999nF/99.99nF/999.9nF/9.999μF/99.99μF/999.9μF/9.999mF	±(4%+5)	±(4%+5)
Frequency (Hz)	10.00Hz~1.000MHz	±(0.1%+5)	
Temperature (°C)	-40°C~1000°C	±(1%+4)	
Temperature (°F)	-40°F~1832°F	±(1.5%+5)	

Features

Display count		6000	6000
Range selection		Auto	Manual
Diode		✓	✓
Continuity buzzer		✓	✓
Battery test	Tests 1.5V and 9V batteries and displays 'good', 'low', 'bad' status		✓
NCV		✓	✓
LCD backlight		✓	✓
Test probe holder		✓	✓
Data hold		✓	✓
Low battery indication		✓	✓
Overload indication		✓	✓

GENERAL CHARACTERISTICS

Power	1.5V battery (R03) x 2
Display	56.8mm x 36.1mm
Product color	Red and grey
Product net weight	255g (with batteries)
Product size	155mm x 76.5mm x 49mm
Standard accessories	Manual, test leads, K-type thermocouple (UT133A)
Standard individual packing	Gift box, English manual
Standard quantity per carton	350mm x 335mm x 318mm
Standard carton measurement	30pcs
Standard carton gross weight	12.5kg