PXI Modules

3030A Wideband RF Digitizer

Fully featured wideband PXI RF Digitizer module for complex signal analysis applications in communications system test

- Frequency range 330 MHz to 3 GHz
- 36 wide MHz digitized corrected bandwidth
- 14 bit A/D resolution with 103.68 MHz sample rate
- 75 dB spurious free dynamic range
- 75 dB intermodulation free dynamic range
- Noise spectral density <-145 dBm/Hz
- Excellent level accuracy of typically 0.3 dB
- List Mode for fast frequency and level settling
- Digital IQ or digital IF output
- 128 M samples digital IF memory
- Real time digital IF/IQ output via LVDS interface
- IF In and IF Out
- FFT Spectrum Analyzer Measurement Suite
- PXI Studio application software

Analyzing RF communciations signals has never been more flexible

The combination of PXI modules 3030A and 3010 form a compact 3U high precision RF Digitizer occupying just 3 slots. Together with measurement application software supplied they provide first class vector signal analysis of RF signals. Their functionality and performance are ideally matched to the needs of RF test systems for manufacturing or design verification.

The 2 slot wide 3030A frequency down converts and digitizes RF signals in the range 330 MHz to 3 GHz providing an instantaneous analysis bandwidth of up to 36 MHz. The single slot wide 3010 / 3011 RF Synthesizer module provides the low phase noise, frequency agile local oscillator input to the RF digitizer.

The 3030A offers high linearity, low noise and excellent level accuracy performance making it especially suited for the analysis of WLAN, WMAN and 2G / 3G cellular radio signals. The 3030A outputs amplitude and phase corrected digital IF or IQ data samples with an absolute amplitude accuracy of better than 0.45 dB (typically 0.3 dB). Correction ensures amplitude flatness is maintained better than 0.25 dB across 33 MHz bandwidth with phase compensation better than 0.03 radians pk-pk.

The Aeroflex PXI Studio application software provides a basic framework for vector signal analysis. As standard PXI Studio supports hardware configuration, control and display of IQ data in various domains ideal for general purpose testing and alignment of radio communications transmitters and components. As they become available, optional measurement library plugins to the basic software can then easily be added. Plugin libraries integrate existing .dll measurement library options within the PXI Studio framework thereby providing an intuitive API and a highly flexible graphical user interface. Plugin support of specific communications system personalities will extend to include GSM/EDGE, UMTS/HSUPA UL, cdma2000/1xEV-DO reverse link, WLAN and WMAN (WiMAX) signal analysis in additon to general purpose Spectrum Analysis.

Advantages of PXI

The 3030A RF digitizer offers significant economies compared to general purpose rack and stack instruments without compromising performance. In part this is achieved by exploiting the benefits of the PXI specification, an industry standard open architecture for modular instrumentation. Using PXI enables faster measurement speed, smaller size and greater flexibility for easier system integration and future system evolution.

Applications

The RF Digitizer is an essential component within any development or manufacturing RF test system designed around the needs of advanced digital communications standards as used in WLAN, WMAN and cellular communications. The 3030A is equally beneficial for applications in satellite and terrestrial broadcasting and military communications. Whether the application is for test, measurement or system emulation, the 3030A delivers the functionality and performance required. When used in conjunction with other Aeroflex PXI RF modules, complete RF test systems can be designed. The 3030A RF digitizer is complementary to the 3020 series digital RF signal generators which can provide wideband linear modulated RF signal generation up to 6 GHz with integrated dual channel arbitrary waveform generator.

Performance Highlights

Wide Frequency Range: The 3030A provides continuous frequency coverage from 330 MHz to 3 GHz with 1 Hz resolution. This satisfies the requirements for all mobile phone operating bands as well as WLAN, WLAN licenced and unlicenced bands below 3 GHz.

Level Range: Full dynamic range is provided for signal input powers up to +10 dBm peak. The maximum safe input range is extended to + 22 dBm (with 8 dB input attenuation selected). With a noise spectral density specification of –145 dBm/Hz, the 3030A is able to discern very low level signals, especially useful when measuring transmitter spurious outputs. RF Input level control is provided using reliable, fast electronic switched attenuation selectable in small 4 dB steps to help maximize the useable dynamic range.

Level Accuracy: The 3030A is ideal for making accurate RF power measurements in high volume manufacturing. A typical 0.3 dB total measurement uncertainty together with <0.05 dB repeatability error ensures that a high yield can be maintained.

High Dynamic Range: The 3030A is purpose designed for difficult transmitter measurements such as burst power and spectral emissions on WLAN/WMAN, 2G and 3G cellular terminals. With a spectral density of –145 dBm/Hz, 3030A is able to measure steep power ramps as generated by 2G, 3G and WLAN/WMAN radio transmission equipment. For GSM type signals, power ramps of 80dB can be measured. The digitizer typically provides 75 dB of spurious free dynamic range and 75 dB intermodulation free dynamic range. This together with excellent phase noise performance makes it possible to measure an ACLR of typically 68 dB on 3G terminals. Frequency conversion is performed using a highly linear single stage down converter which offers a TOI of +30 dBm and low conversion loss.

Wide Bandwidth: The 3030A provides a bandwidth of 36 MHz with phase and amplitude correction across 33 MHz. This can help improve measurement speed by making it possible to use a single capture to acquire multiple carriers or wide band width modulated signals such as used in emerging WLAN standards.

Low Phase Noise: The 3030A module is designed to be used either with a PXI 3010 or 3011 RF synthesizer module. This provides a low noise agile local oscillator signal from which the 3030A phase noise is defined. Phase noise at 20 kHz offset from carrier is typically -115 dBc/Hz at 2 GHz while he noise floor from 10 MHz offset is typically –138 dBc/Hz. Frequency settling can be achieved in typically 250 μs, (3010 opt 01 fitted) making the 3030A ideal for high productivity RFIC testing.

IF Input: The 3030A will accept a direct IF input signal at 77.76 MHz with a maximum input level of +10 dBm.

Flexible ADC: Full rate digital IF or decimated IQ data can be streamed via a LVDS data interface on the front panel. This is especially useful for realtime system emulation applications. Data can also be captured to internal memory then read over the PCI bus. Internal memory provides storage for up to 128 M x 16 bit samples of IF data sampled at 103.68 Msamples per second, equivalent to 1.2 seconds. The sample rate is user defined and independent of the sampling clock over the range 6.328 ks/s to 85 Ms/s. Lowering the sample rate improves data transfer rates and allows much longer events to be captured.

Small Size: The 3030A is unparalleled in terms of size. The module occupies just 2 slots in a 3U PXI rack. An additional slot is required to accommodate the 3010 RF synthesizer making a total of just 3 slot widths required for a complete RF digitizer.

Acquisition, Data Transfer and Measurement Speed: Data acquisition, data transfer and measurement processing can be performed serially or overlapped. New data acquisition can be initiated in parallel to processing a previous capture sample thus leading to faster measurement time. Data transfer time to the CPU is performed at a rate of up to 20 MSamples/s (IF data) or 10 Million IQ pairs per second while measurement processing time varies according to CPU speed and the application.

Triggering and Synchronization: The 3030A module can frequency lock to a 10 MHz reference signal supplied by the 3010.

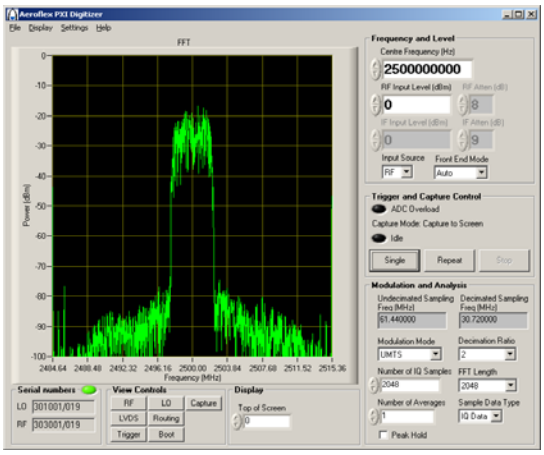
The 3030A supports external trigger sources. Triggers can be applied either from the PXI backplane or directly through the front panel LVDS and TTL interfaces.

The 3030A is able to initiate data capture based on an internal IF trigger derived from sample data. IF triggering can be set as absolute, with a user defined threshold level, or relative in which case a power change results in trigger activation. Both trigger modes have settable time constants for noise filtering making it possible to avoid false triggering on transients. All trigger modes are supported by user definable pre- and post trigger delays. 3030 data acquisition is also able to be gated. The sample length is then defined by the duration of the externally applied gate.

List Mode: This feature enables the 3030A to be preloaded with up to 128 combinations of different frequency and level settings. All 3030A internal hardware settings are pre-calculated making re-selection of a new frequency and level possible in typically 250 μs, (3010 opt 01 fitted) while still maintaining level accuracy. This feature is ideally suited for fast mobile phone transmitter alignment applications and is complimented by similar features in the 3020 series RF Signal Generator in support of the corresponding fast mobile phone receiver alignment.

Software

The 3030A is supplied with a variety of software including; measurement applications with optional system personality plugins, measurement suites (function libraries), instrument drivers and soft front panels.

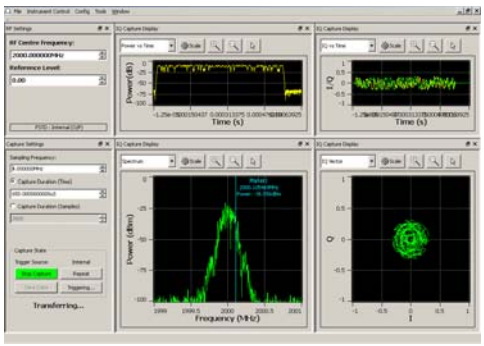


3030A Soft Front Panel

Driver Software All 3030 series modules are supplied with mutli layered software APIs and GUIs starting with a low level vxi pnp module driver to control the digitizer independently and then a higher level driver providing a single combined interface to both the 3030 and 3010 series modules. Each driver is supplied with a .dll API and is supported with a soft front panel GUI to aid manual operation and debugging during applications development.

Application Software The 3030 series module is supplied with application software 'PXI Studio' which provides a high level fully intergrated API and GUI to all Aeroflex 3000 series signal generator, digitizer, local oscillator and combiner modules and measurement libraries. This vastly simplies the effort required to integrate PXI without compromising flexibility.

The basic application supports module hardware configuration and control through a single GUI and integrates measurement libraries through a series of standard and optional plugins. The basic PXI Studio application provides spectrum analyser functions as well as allowing display of IQ data in various domains including ampltude vs frequency, amplitude vs time, phase vs time, I vs Q (amplitude vs phase). This application is ideal for general purpose measurements in a wide variety of communication applications and particularly suited for fast characterization and alignment of radio transmitters.



PXI Studio screen shot

FFT Spectrum Analyzer Measurement Suite Highlights

As standard 3030 series modules are supplied with an FFT Spectrum measurement suite comprising a library of hardware independent functions for frequency and time domain analysis of digitized IQ data. To assist with programming, source code examples and user help are provided for a wide variety of different applications development environments including LabView, LabWidows CVI, VB and Visual C.

FFT analysis can be performed with a maximum span of 200 MHz.. The resolution bandwidth is continuously variable using 3 dB or Noise Equivalent Bandwidth windows with a minimum resolution of <1Hz.

Channel Power and Adjacent Channel Power Measurement The user defines the channel configuration to be measured (i.e. channel width; channel spacing; center frequency; etc). The measurement then computes the central channel RMS power as an absolute and the adjacent channel powers relative to this from the FFT spectrum. Four adjacent channels are examined (two either side of the central channel).

Occupied Bandwidth is calculated from the FFT spectrum by a function that returns the bandwidth in which a user defined percentage of the total signal power is occupied.

The FFT spectrum can be configured as either RMS averaged or peak hold in which case the function will output an averaged result or retain peak values if repeatedly called. The number of averages is user defined.

A marker power function is provided together with a marker peak find and a next peak search function. These enable measurement of discrete signals within the FFT spectrum.

Time domain analysis functions include computation of average power of a range of IQ data samples plus power and frequency versus time. The time window for analysis can be the entire IQ sample array or any user defined subset.

Optional Measurement Suites. Signal analysis measurement suites are also available for measurement of GSM/EDGE, WiMAX WLAN, UMTS uplink and cdma2000 uplink transmissions. (See separate datasheets for 3030 options 100 to 104). These provide measurement of power, modulation quality and spectrum parameters in accordance with the relevant standards for mobile terminal testing, ideal for both production line and development laboratory use. Each application library is supplied with example source code to help familiarize the user.

Customer Support

Users can elect to purchase PXI modules with optional warranty extensions. Standard Extended Warranty provides either a 36 month or 60 month warranty period plus the benefits of guaranteed product repair times in the event of failure. Standard Extended Warranty can also be provided inclusive of scheduled calibration. On request Aeroflex can provide customized Premium Warranty support designed around your specific needs.

SPECIFICATION

All 3030A specifications are defined when used in conjunction with 3010/11 RF Synthesizer PXI module.

FREQUENCY

Range

RF input: 330 MHz to 3.0 GHz
IF input: Centered on 77.76 MHz

Resolution

1 Hz

Accuracy

As per frequency reference

Settling Time

Time taken to be within 1 kHz of final frequency

3010 in Normal Loop Bandwidth:

As standard:

Typically 1.1 ms

With 3010 option 01 fitted:

List Mode: (requires PXI local bus left connection to 3010/3011)

hardware triggered; Typically 250 µs

3010 in Narrow Loop Bandwidth:

Typically 10 ms

LEVEL

Input Coupling

AC Coupled

Input Power

Max RF input +16 dBm continuous, (+22 dBm with 8 dB of RF input attenuation)

Max IF input +10 dBm with 0 dB of IF attenuation

RF Input Attenuator

0 to 28 dB in 4 dB steps

IF Input Attenuator

0 to 35 dB in 1 dB steps

RF Input Return Loss

16 dB with 8 dB or more RF attenuation

Level Accuracy (RF input, 23°C ±5°C, Auto Flatness Mode enabled)

Better than ±0.45 dB, typically 0.3 dB

Valid for signals with <5 MHz occupied bandwidth at the tuned frequency and S/N ratio >40 dB

Level Settling Time

Typically 250 µs settled with 0.3 dB of final value

Level Temperature Stability

±/-0.01 dB/°C

Level Repeatability

Better than ±0.05 dB after warm up following a return from a change in frequency or level. Valid for at least 2 hours and excluding temperature influence.

LIST MODE

List Mode Channel Parameters

RF Frequency, RF/IF Level (defined as input level or as 3030A RF and IF attenuator settings

List Addresses

128 numbered 0 to 127

Settling Time

See frequency and level data

Address Sources

Manual (software commanded)
External (hardware triggered)
Internal (counter timer)

Extrernal Mode Trigger Sources

PXI Trigger Bus, Star Trigger, PXI Local Bus, LVDS Aux 1 to 5, TTL+ve, TTL-ve

Counter Mode (internal)

Dwell time 250 µs to 10 seconds with resolution 10 µs

SPECTRAL PURITY

SSB Phase Noise

Typical at 2 GHz and at ambient room temperature

Loop Bandwidth	***Narrow***	***Wide (normal)***
Offset	dBc/Hz	dBc/Hz
100 Hz	-55	-85
1 kHz	-85	-103
10 kHz	-114	-103
20 kHz	-116	-110
100 kHz	-133	-130
1 MHz	-136	-136
10 MHz	-138	-138

Phase noise below 100 Hz is dependent upon reference phase noise.

LINEARITY AND NOISE

(Specifications apply to RF input)

Intermodulation

Typically 75 dB intermodulation free dynamic range (2 tone input with maximum 0 dBm input power for each tone) Manual mode

Adjacent Channel Leakage Ratio (ACLR)

Better than 63 dB ACLR on 3GPP (downlink test model 1)
Typically 68 dB ACLR on 3GPP uplink

Spurious

Typically -75 dBc excluding IF image frequencies and harmonic responses

Residual Responses (no signal input)

-100 dBm with RF input terminated into 50 ohms and minimum RF and IF attenuation

Noise Spectral Density (no signal input)

RF input terminated in 50 ohms and minimum RF and IF attenuation

Below 1 GHz, <-145 dBm/Hz
1 GHz and above, <-140 dBm/Hz

IF OUTPUT

Frequency

Center 77.76 MHz

Level

Relative to RF input (0 dB input attenuation selected)
Typically -3 dB between 330 MHz to 2.5 GHz
Typically -5 dB between 2.5 GHz to 3 GHz

Bandwidth

Typically >100 MHz (-3 dB)

A/D CONVERSION

Resolution

14 bits

ADC Clock

Fixed 103.68 MHz

Sample Rate Control

IF: 103.68 MHz
IQ: Variable 6328.125 S/s to 85 MS/s or 51.84 MS/s with LVDS output enabled

Sample Rate Resolution

0.1 Hz when the sample rate is entered as a real number
Sample rate can be entered as a fraction made up of integers

Sample Rate Accuracy

As per 10 MHz ref[1]

[1] add ±2 µHz when using generic resampling mode

Amplitude Flatness (correction on)

Flatness correction on: 0.25 dB to 33 MHz, 0.1 dB across center 5 MHz

Phase Flatness (typical with correction on)

0.03 radians pk-pk to 33 MHz

Data Output

A sample data block (equal to the data capture length) can be stored to the memory internal to the 3030 and then transferred to the controller via the PCI bus. Sample data can be continuously streamed out of the LVDS connector.

IF data samples have 16 bit resolution. IQ data samples can be 16 or 32 bit resolution.

Data Transfer Rate

Typically 10 Mwords/s (a word is 32 bits long)

IQ and IF block data transfer when using 2.2 GHz embedded CPU running windows XP

Sample Memory

128 M x 16 bit samples

TRIGGERING

Trigger Mode

Single, Repeat

Trigger Type

Edge, Gated, NONE (software triggered)

Hardware Trigger Sources

Internal (IF, derived from IQ data with user defined level control)
External (LVDS, LBL, Trig Bus, Star Trigger, TTL)

Trigger Polarity

+ve or –ve (Edge trigger) Gate High, Gate Low (Gated trigger)

TRIGGER FUNCTIONS

Pre-trigger

0 to sample length

Delayed Trigger

–10 to + 2G samples

Trigger Latency

0 to 1 sample at the output sample rate

FFT SPECTRUM ANALYZER MEASUREMENT SUITE

FFT Length

2^n for n = 7 to 16

Measurement Bandwidth

2 Hz up to 10 MHz

Window Type

NEBW: Gaussian 3 dB: Gaussian Fixed: Blackman Harris 5 term

Channel Power and Adjacent Channel Power

Adjacent Channels: 2 upper and 2 lower subject to 33 MHz bandwidth limitation

Channel filter alpha: 0 to 1
Channel spacing: up to 15 MHz
Channel width: up to 25 MHz

Occupied Bandwidth (OBW)

Percentage range: 1% to 99.99%

Marker Functions

Marker power, peak search, next peak

Time Domain Functions

(Computed for the entire IQ sample record or any subset) Average Power, Power versus Time, Frequency versus Time

INTERFACES

3010/11

LO output, (SMA)

10 MHz reference I/O (SMA x 2)

PCI bus interface including PXI triggering functions

3030A

RF input (SMA)

Local oscillator input (SMA)

IF output and; IF input (SMA * 2)

10 MHz reference (SMA * 2)

IF or IQ 16 bit LVDS data (VHDCI)

PCI bus interface including PXI triggering functions

TTL trigger (SMB)

POWER CONSUMPTION (TYPICAL)

	3010/3011	3030A
+3.3 V	50 mA[1]	3 A
+5 V	650 mA	1.5 A
+12 V	50 mA[2]	300 mA
-12 V	30 mA	150 mA

1. 250 mA transiently during power up

2. 3011 OCXO requires 300 mA startup reducing to 150 mA after 5 minutes

DIMENSIONS AND WEIGHT

Dimensions

3010/11 Single width 3U PXI module 3030A Double width 3U PXI module

Weight

3010 375 g (0.8 lbs)

3011 390 g (0.86 lbs)

3030A 750 g (1.7 lbs)

FREQUENCY REFERENCE IN

Mode

External, Free Running (3030A)

External Source

SMA

Frequency

10 MHz

Level

0.4 V to 4 V pk-pk into 50 ohms or looped through

GENERAL

The following general specifications are common to the 3010, 3011 and 3030A

Standard Warranty

24 months

Calibration Interval

Recommended 24 months

Electromagnetic Compatibility

EN 61326-1:1997, Emissions Class A, Immunity Table 1 - Performance Criteria B

Safety

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control and laboratory use-Part 1, General requirements

Driver Software

VXIpnp compliant software driver

LOCAL OSCILLATOR

Frequency range

1500 MHz to 3000 MHz

Level

3010 output: -4 dBm to +3 dBm 3030A input: Nominally 0 dBm

RATED RANGE OF USE

Operating Temperature

0 to 50°C, meets IEC-60068-2-1 and 60068-2-2

Operating Humidity

10 to 90% non-condensing, meets IEC-60068-2-56

CONDITIONS OF STORAGE AND TRANSPORT

Storage Temperature

-20 to +70°C, meets IEC-60068-2-1 and 60068-2-2

Storage Humidity

5 to 93% non-condensing, tested to IEC-60068-2-56

Shock

30 g peak, half sine, 9 ms pulse. Tested in accordance with IEC-60068-2-27

Random vibration 5 Hz to 500 Hz, 2.46 g rms non-operating. Tested in accordance with IEC-60068-2-64

COMPLIANCE

PXI Specification, Revision 2.1
VXIplug&play Specifications (VPP-2, VPP-3.x, VPP-4.x and VPP-7)

3010/3011 SPECIFIC SPECIFICATIONS

Specifications are common to the 3010 and 3011 unless otherwise stated.

LO OUTPUT

Frequency Range

1.5 GHz to 3.0 GHz

Resolution

1 Hz

Accuracy

As frequency standard

Output Power

Fixed level in the range -4 dBm to +3 dBm

Output Impedance

50 Ω nominal

VSWR

<2:1

FREQUENCY REFERENCE OUT (3011 ONLY)

Level

2 V pk-pk nominal square wave into 50 ohms

Frequency

10 MHz

Aging Rate

1 in 10^9 per day, 1 in 10^7 per year

Temperature Stability (0 to 50°C)

Typically better than $\pm 1 \times 10^{-8}$

Warm-Up Time

<5 Minutes

VERSIONS, OPTIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

Ordering Numbers	Versions
3030A	PXI Wideband RF Digitizer
3010	PXI RF Synthesizer
3011	PXI RF Synthesizer (including OCXO 10 MHz reference)
	Supplied with:
	The 3030A and 3010/11 are each supplied with:
	CD ROM containing drivers, application software and user documentation.
	CD ROM containing factory test data and calibration certificate
	2 x SMA-SMA links
	Options
3010/11 Opt 01	High speed frequency switching (subject to export control)
	Optional Application Libraries (supplied on separate CDROM) See separate data sheets
3030 Opt 100	GSM/EDGE measurement suite
3030 Opt 101	UMTS/HSUPA uplink measurement suite
3030 Opt 102	cdma2000/1xEV-DO reverse link measurement suite
3030 Opt 103	WLAN measurment suite
3030 Opt 104	WiMAX measurement suite

When purchased as an upgrade, order as:

RTROPT100/3030 GSM/EDGE enable

RTROPT101/3030 UMTS uplink enable

RTROPT102/3030 cdma2000 reverse link enable

RTROPT103/3030 WLAN enable

RTSOPT104/3030 WiMAX enable

	Service Options
W3010/103	3010 Standard Extended Warranty 36 months
W3030/103	3030 Standard Extended Warranty 36 months
W3010/103C	3010 Standard Extended Warranty 36 months with scheduled calibration
W3030/103C	3030 Standard Extended Warranty 36 months with scheduled calibration
W3010/105	3010 Standard Extended Warranty 60 months
W3030/105	3030 Standard Extended Warranty 60 months
W3010/105C	3010 Standard Extended Warranty 60 months with scheduled calibration
W3030/105C	3030 Standard Extended Warranty 60 months with scheduled calibration
	Optional Accessories
43139/590	SMA link cable
23435/698	68 way VHDCI to SCSI-3 cable assy 1.8 m
23435/699	68 way VHDCI to VHDCI cable assy 1.8 m
46885/224	SMA connector saver
82536	PXI assy, 8 slot chassis with 2.2 GHz P4 embedded controller (Windows XP)
82544	PXI assy, 8 slot chassis with MXI-4 PCI-PXI interface
82538	PXI assy, 18 slot chassis with 2.2 GHz P4 embedded controller (Windows XP)
82545	PXI assy, 18 slot chassis with MXI-4 PCI-PXI interface
46662/767	PXI hard carry case (for use with 82536, 82544)

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A passion for performance.

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Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

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