



# Debug Information Extended Instruction Set Specification

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# Chapter 1. Introduction

This is the specification of **DebugInfo** extended instruction set.

The library is imported into a SPIR-V module in the following manner:

```
<extinst-id> OpExtInstImport "DebugInfo"
```

The instructions below are capable to convey debug information of the source program.

The design guide lines for these instructions are:

- Sufficient for a backend to generate DWARF4 debug info for OpenCL C/C++ kernels
- Easy translation between SPIR-V/LLVM
- Clear
- Concise
- Extendable for other languages
- Capable of representing debug information for optimized IR

## Chapter 2. Binary Form

This section contains the semantics of the debug info extended instructions using the **OpExtInst** instruction.

All *Name* operands are id of **OpString** instruction, which represents the name of the entry (type, variable, function. etc) as it appears in the source program.

*Result Type* of all instructions bellow is id of **OpTypeVoid**

*Set* operand in all instructions bellow is the result of an **OpExtInstImport** instruction.

All instructions in this extended set has no semantic impact and can be safely removed from the module all at once. Or a single debugging instruction can be removed from the module if all references, to the *Result* *<id>* of this instruction are replaced with id of **DebugInfoNone** instruction.

**DebugScope**, **DebugNoScope**, **DebugDeclare**, **DebugValue** instructions can interleave with instructions within a function body. All other debugging instructions should be located between section 9 (All type declarations (**OpTypeXXX** instructions), all constant instructions, and all global variable declarations ...) and section 10 (All function declaration) per the core SPIR-V specification.

Debug info for source language opaque types is represented by **DebugTypeComposite** without *Members* operands. *Size* of the composite must be **DebugInfoNone** and *Name* must start with @ symbol to avoid clashes with user defined names.

# Chapter 3. Enumerations

## 3.1. Instruction Enumeration

Instruction number	Instruction name
0	<a href="#">DebugInfoNone</a>
1	<a href="#">DebugCompilationUnit</a>
2	<a href="#">DebugTypeBasic</a>
3	<a href="#">DebugTypePointer</a>
4	<a href="#">DebugTypeQualifier</a>
5	<a href="#">DebugTypeArray</a>
6	<a href="#">DebugTypeVector</a>
7	<a href="#">DebugTypedef</a>
8	<a href="#">DebugTypeFunction</a>
9	<a href="#">DebugTypeEnum</a>
10	<a href="#">DebugTypeComposite</a>
11	<a href="#">DebugTypeMember</a>
12	<a href="#">DebugTypeInheritance</a>
13	<a href="#">DebugTypePtrToMember</a>
14	<a href="#">DebugTypeTemplate</a>
15	<a href="#">DebugTypeTemplateParameter</a>
16	<a href="#">DebugTypeTemplateTemplateParameter</a>
17	<a href="#">DebugTypeTemplateParameterPack</a>
18	<a href="#">DebugGlobalVariable</a>
19	<a href="#">DebugFunctionDeclaration</a>
20	<a href="#">DebugFunction</a>
21	<a href="#">DebugLexicalBlock</a>
22	<a href="#">DebugLexicalBlockDiscriminator</a>
23	<a href="#">DebugScope</a>
24	<a href="#">DebugNoScope</a>
25	<a href="#">DebugInlinedAt</a>



Instruction number	Instruction name
26	<a href="#">DebugLocalVariable</a>
27	<a href="#">DebugInlinedVariable</a>
28	<a href="#">DebugDeclare</a>
29	<a href="#">DebugValue</a>
30	<a href="#">DebugOperation</a>
31	<a href="#">DebugExpression</a>
32	<a href="#">DebugMacroDef</a>
33	<a href="#">DebugMacroUndef</a>

## 3.2. Debug Info Flags

Value	Flag Name
1 << 0	FlagsProtected
1 << 1	FlagsPrivate
1<<1   1<<0	FlagsPublic
1 << 2	FlagsLocal
1 << 3	FlagsDefinition
1 << 4	FlagFwdDecl
1 << 5	FlagArtificial
1 << 6	FlagExplicit
1 << 7	FlagPrototyped
1 << 8	FlagObjectPointer
1 << 9	FlagStaticMember
1 << 10	FlagIndirectVariable
1 << 11	FlagLValueReference
1 << 12	FlagRValueReference
1 << 13	FlagsOptimized

## 3.3. Base Type Attribute Encodings

Used by [DebugTypeBasic](#)

Encoding code name	
0	Unspecified
1	Address
2	Boolean
4	Float
5	Signed
6	SignedChar
7	Unsigned
8	UnsignedChar

## 3.4. Composite Types

Used by [DebugTypeComposite](#)

Tag code name	
0	Class
1	Structure
2	Union

## 3.5. Type Qualifiers

Used by [DebugTypeQualifier](#)

Qualifier tag code name	
0	ConstType
1	VolatileType
2	RestrictType

## 3.6. Debug Operations

Used by [DebugExpression](#)

Operation encodings		No. of Operands
0	Deref	0
1	Plus	0
2	Minus	0
3	PlusUconst	1

Operation encodings		No. of Operands
4	<b>BitPiece</b>	2
5	<b>Swap</b>	0
6	<b>Xderef</b>	0
7	<b>StackValue</b>	0
8	<b>Constu</b>	1

# Chapter 4. Instructions

## 4.1. Absent Debugging Information

### DebugInfoNone

Other instructions can refer to this one in case the debugging information is unknown, not available or not applicable.

*Result Type* must be **OpTypeVoid**

5	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> Set	0
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## 4.2. Compilation Unit

### DebugCompilationUnit

Describe compilation unit.

*Result Type* must be **OpTypeVoid**

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Version* is version of SPIRV debug information specification.

*DWARF Version* is version of DWARF standard this specification is compatible with.

8	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> Set	1	<id> Source	<i>Literal Number Version</i>	<i>Literal Number DWARF version</i>
---	----	----------------------------	--------------------	----------	---	-------------	-------------------------------	-------------------------------------

## 4.3. Type instructions

### DebugTypeBasic

Describe basic data types.

*Result Type* must be **OpTypeVoid**

*Name* represents the name of the type as it appears in the source program. May be empty.

*Size* is an **OpConstant** with integral type and its value is amount of storage in bits, needed to hold an instance of the type.

*Encoding* describes how the base type is encoded.

8	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> Set	2	<id> Name	<id> Size	<i>Encoding</i>
---	----	----------------------------	--------------------	----------	---	-----------	-----------	-----------------

## DebugTypePointer

Describe pointer or reference data types.

*Result Type* must be **OpTypeVoid**

*Base Type* is *<id>* of debugging instruction which represents the pointee type.

*Storage Class* is the class of the memory where the pointed object is allocated. Possible values of this operand are described in the "Storage Class" section of the core SPIR-V specification.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the [Debug Info Flags](#) table.

8	12	<i>&lt;id&gt; Result Type</i>	<i>Result &lt;id&gt;</i>	<i>&lt;id&gt; Set</i>	3	<i>&lt;id&gt; Base Type</i>	<i>Storage Class</i>	<i>Literal Flags</i>
---	----	---------------------------------------	------------------------------	-----------------------	---	-----------------------------	----------------------	----------------------

## DebugTypeQualifier

Describe *const*, *volatile* and *restrict* qualified data types. Types with multiple qualifiers are represented as a sequence of single qualified types.

*Result Type* must be **OpTypeVoid**

*Base Type* is debug instruction which represents the type being qualified.

*Type Qualifier* is a literal value from the [TypeQualifiers](#) table.

7	12	<i>&lt;id&gt; Result Type</i>	<i>Result &lt;id&gt;</i>	<i>&lt;id&gt; Set</i>	4	<i>&lt;id&gt; Base Type</i>	<i>Type Qualifier</i>
---	----	-----------------------------------	--------------------------	-----------------------	---	-----------------------------	-----------------------

## DebugTypeArray

Describe array data types

*Result Type* must be **OpTypeVoid**

*Base Type* is debugging instruction which describes type of element of the array

*Component Count* is an **OpConstant** with integral result type, and its value is the number of elements in the corresponding dimension of the array. Number and order of *Component Count* operands must match with number and order of array dimensions as they appear in the source program.

7+	12	<i>&lt;id&gt; Result Type</i>	<i>Result &lt;id&gt;</i>	<i>&lt;id&gt; Set</i>	5	<i>&lt;id&gt; Base Type</i>	<i>&lt;id&gt; Component Count, ...</i>
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## DebugTypeVector

Describe vector data types

*Result Type* must be **OpTypeVoid**

*Base Type* is id of debugging instruction which describes type of element of the vector

*Component Count* is a single *word* literal denoting number of elements in the vector.

7	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> <i>Set</i>	6	<id> <i>Base Type</i>	<i>Literal Number</i> <i>Component Count</i>
---	----	----------------------------	--------------------	-----------------	---	-----------------------	---

## DebugTypedef

Describe a C and C++ *typedef* declaration

*Result Type* must be **OpTypeVoid**

*Name* is **OpString** which represents a new name for the *Base Type*

*Base Type* is a debugging instruction representing the type for which a new name is being declared

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the declaration appears on the *Line*.

*Parent* is a debug instruction which represents the parent lexical scope of the declaration.

11	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> <i>Set</i>	7	<id> <i>Name</i>	<id> <i>Base Type</i>	<id> <i>Source</i>	<i>Literal Number</i> <i>Line</i>	<i>Literal Number</i> <i>Column</i>	<id> <i>Parent</i>
----	----	----------------------------	--------------------	--------------------	---	---------------------	-----------------------	-----------------------	--------------------------------------	--	-----------------------

## DebugTypeFunction

Describe a function type

*Result Type* must be **OpTypeVoid**

*Return Type* is a debug instruction which represents type of return value of the function. If the function has no return value, this operand is **OpTypeVoid**

*Parameter Types* are debug instructions which describe type of parameters of the function

6+	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> <i>Set</i>	8	<id> <i>Return Type</i>	<id>, <id>, ... <i>Parameter Types</i>
----	----	----------------------------	--------------------	-----------------	---	-------------------------	---

## DebugTypeEnum

Describe enumeration types

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString** holding the name of the enumeration as it appears in the source program.

*Underlying Type* is a debugging instruction which describes the underlying type of the enum in the source program. If the underlying type is not specified in the source program, this operand must refer to [DebugInfoNone](#).

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the enumeration declaration appears in the *Source*.

*Column* is a single *word* literal denoting column number at which the first character of the enumeration declaration appears on the *Line*.

*Parent* is a debug instruction which represents a parent lexical scope.

*Size* is an **OpConstant** with integral result type, and its value is the number of bits required to hold an instance of the enumeration.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the [Debug Info Flags](#) table.

Enumerators are encoded as trailing pairs of *Value* and corresponding *Name*. *Values* must be id of **OpConstant** instruction, with integer result type. *Name* must be id of **OpString** instruction.

13	12	<id	Re	<id	9	<id	<id	<id	Literal	Literal	<id>,	<id>	Literal	<id> Value,
+		>	sult	>		>	>	>	Number	Number	Parent	Size	Flags	<id> Name,
			Re	<id	Set		Na	Un	Line	Column				<id> Value,
			sult	>		me	derl	So						<id> Value,
			Type				yin	e						<id> Name,
			e				g							...
							Type							
							e							

## DebugTypeComposite

Describe *structure*, *class* and *union* data types

*Result Type* must be **OpTypeVoid**

*Tag* specifies the kind of composite type

*Name* is an **OpString** holding the name of the type as it appears in the source program

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the type declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the declaration appears on the *Line*

*Parent* is a debug instruction which represents parent lexical scope. Must be one of the following: **DebugCompilationUnit**, **DebugFunction**, **DebugLexicalBlock** or other **DebugTypeComposite**

*Size* is an **OpConstant** with integral type and its value is the number of bits required to hold an instance of the composite type.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the **Debug Info Flags** table.

*Members* must be ids of **DebugTypeMember**, **DebugFunction** or **DebugTypeInheritance**.

**Note:** To represent a source language opaque type this instruction must have no *Members* operands, *Size* operand must be **DebugInfoNone** and *Name* must start with @ symbol to avoid clashes with user defined names.

1	1	<id>	Res	<id>	1	<id>	Tag	<id>	Literal	Literal	<id>	<id>	Literal	<id>, <id>, ... Members
3	2	Res	ult	Set	0	Name		Source	Numbe	Numbe	Parent	Size	Flags	
+		ult	<id>						r Line	r				
		Type							Column					



## DebugTypeMember

Describe a data member of a *structure*, *class* or *union*.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString** holding the name of the member as it appears in the source program

*Type* is a debug type instruction which represents type of the member

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the member declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the member declaration appears on the *Line*

*Parent* is a debug instruction which represents a composite type containing this member.

*Offset* is an **OpConstant** with integral type and its value is offset in bits from the beginning of the *Containing Type*.

*Size* is an **OpConstant** with integral type and its value is the number of bits the *Base type* occupies within the *Containing Type*.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the [Debug Info Flags](#) table.

*Value* is an **OpConstant** representing initialization value in case of *const static* qualified member in C++.

1	1	<id>	Res	<id>	1	<id>	<id>	<id>	Literal	Literal	<id>	<id>	<id>	Flags	Option
4	2	Res	ult	Set	1	Name	Type	Source	Num	Num	Parent	Offset	Size		al <id>
+		ult	Type	<id>					ber Line	ber Colum					Value
		e							n	n					

## DebugTypeInheritance

Describe inheritance relationship with a parent *class* or *structure*. Result of this instruction should be used as a member of a composite type

*Result Type* must be **OpTypeVoid**

*Child* is a debug instruction representing a derived *class* or *struct* in C++.

*Parent* is a debug instruction representing a class or structure the *Child Type* is derived from.

*Offset* is an **OpConstant** with integral type and its value is offset of the *Parent Type* in bits in layout of the *Child Type*

*Size* is an **OpConstant** with integral type and its value is the number of bits the *Parent type* occupies within the *Child Type*.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the [Debug Info Flags](#) table.

10	12	<id> Result Type	Result <id>	<id> Set	12	<id> Child	<id> Parent	<id> Offset	<id> Size	Flags
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### DebugTypePtrToMember

Describe a type of an object that is a pointer to a structure or class member

Result Type must be **OpTypeVoid**

Member Type is a debug instruction representing the type of the member

Parent is a debug instruction, representing a structure or class type.

7	12	<id> Result Type	Result <id>	<id> Set	13	<id> Member Type	<id> Parent
---	----	---------------------	-------------	----------	----	------------------	-------------

## 4.4. Templates

### DebugTypeTemplate

Describe an instantiated template of *class*, *struct* or *function* in C++.

Result Type must be **OpTypeVoid**

Target is a debug instruction representing class, struct or function which has template parameter(s).

Parameters are debug instructions representing the template parameters for this particular instantiation.

7	12	<id> Result Type	Result <id>	<id> Set	14	<id> Target	<id>... Parameters
---	----	---------------------	-------------	----------	----	-------------	--------------------

## DebugTypeTemplateParameter

Describe a formal parameter of a C++ template instantiation.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString** holding the name of the template parameter

*Actual Type* is a debug instruction representing the actual type of the formal parameter for this particular instantiation.

If this instruction describes a template value parameter, the *Value* is represented by an **OpConstant** with integer result type. For template type parameter *Value* operand must not be used

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the template parameter declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the template parameter declaration appears on the *Line*

11	12	<id> Result Type	Result <id>	<id> Set	15	<id> Name	<id> Actual Type	<id> Value	<id> Source	Literal Number Line	Literal Number Column
----	----	------------------------	----------------	-------------	----	--------------	------------------------	------------	----------------	---------------------------	-----------------------------

## DebugTypeTemplateTemplateParameter

Describe a template template parameter of a C++ template instantiation.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString** holding the name of the template template parameter

*Template Name* is an **OpString** holding the name of the template used as template parameter in this particular instantiation.

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the template template parameter declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the template template parameter declaration appears on the *Line*

10	12	<id> Result Type	Result <id>	<id> Set	16	<id> Name	<id> Template Name	<id> Source	Literal Number Line	Literal Number Column
----	----	------------------------	----------------	-------------	----	-----------	--------------------------	-------------	---------------------------	-----------------------------

## DebugTypeTemplateParameterPack

Describe expanded template parameter pack in a variadic template instantiation in C++

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString** holding the name of the template parameter pack

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the template parameter pack declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the template parameter pack declaration appears on the *Line*

*Template parameters* are **DebugTypeTemplateParameters** describing the expanded parameter pack in the variadic template instantiation

10	12	<id> Result Type	Result <id>	<id> Set	17	<id> Name	<id> Source	Literal Number Line	Literal Number Column	<id>... Template parameters
+										

## 4.5. Global Variables

## DebugGlobalVariable

Describe a global variable.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString**, holding the name of the variable as it appears in the source program

*Type* is a debug instruction which represents type of the variable.

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the global variable declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the global variable declaration appears on the *Line*

*Parent* is a debug instruction which represents parent lexical scope. Must be one of the following: **DebugCompilationUnit**, **DebugFunction**, **DebugLexicalBlock** or **DebugTypeComposite**

*Linkage Name* is an **OpString**, holding the linkage name of the variable.

*Variable* is id of the global variable or constant which is described by this instruction. If the variable is optimized out, this operand must be **DebugInfoNone**.

*Flags* is a single *word* literal formed by bitwise OR-ing values from the **Debug Info Flags** table.

If the global variable represents a defining declaration for C++ static data member of a structure, class or union, the optional *Static Member Declaration* operand refers to the debugging type of the previously declared variable, i.e. **DebugTypeMember**

1	1	<id>	Res	<id>	1	<id>	<id>	<id>	Literal	Literal	<id>	<id>	<id>	Flags	Option
4	2	Res	ult	Set	8	Name	Type	Source	Numb	Numb	Parent	Linkag	Variabl		al <id>
+		ult	<id>						er Line	er		e	e		Static
		Type							Column	Column		Name			Member
		e							n	n					Declaration

## 4.6. Functions

## DebugFunctionDeclaration

Describe function or method declaration.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString**, holding the name of the function as it appears in the source program

*Type* is an **DebugTypeFunction** instruction which represents type of the function.

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the function declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the function declaration appears on the *Line*

*Parent* is a debug instruction which represents parent lexical scope.

*Linkage Name* is an **OpString**, holding the linkage name of the function

*Flags* is a single *word* literal formed by bitwise OR-ing values from the **Debug Info Flags** table.

1	1	<id>	Result	<id>	1	<id>	<id>	<id>	Literal	Literal	<id>	<id>	Flags
3	2	Result	It	Set	9	Name	Type	Source	Number	Number	Parent	Linkage	
		Type	<id>						Line	Column		Name	

## DebugFunction

Describe function or method definition or declaration.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString**, holding the name of the function as it appears in the source program

*Type* is an **DebugTypeFunction** instruction which represents type of the function.

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the function declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the function declaration appears on the *Line*

*Parent* is a debug instruction which represents parent lexical scope.

*Linkage Name* is an **OpString**, holding the linkage name of the function

*Flags* is a single *word* literal formed by bitwise OR-ing values from the **Debug Info Flags** table.

*Scope Line* a single *word* literal denoting line number in the source program at which the function scope begins.

*Function* is an **OpFunction** which is described by this instruction.

*Declaration* is **DebugFunctionDeclaration** which represents non-defining declaration of the function.

1	1	<id>	Res	<id>	2	<id>	<id>	<id>	Literal	Literal	<id>	<id>	Flags	Literal	<id>	Optio
5	2	>	ult	>	0	Name	Type	Sourc	Numb	Numb	Parent	Linka		Numb	Functi	nal
+		Res	<id	Set				e	er	er		ge		er	on	<id>
		ult	>						Line	Colum		Name		Scope		Declar
		Type								n				Line		ation
		e														

## 4.7. Location Information

## DebugLexicalBlock

Describe a lexical block in the source program.

*Result Type* must be **OpTypeVoid**

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the lexical block begins in the *Source*

*Column* is a single *word* literal denoting column number at which the lexical block begins.

*Parent* is a debug instructions describing the scope containing the current scope. Entities in the global scope should have *Parent* referring to **DebugCompilationUnit**.

Presence of the *Name* operand indicates that this instruction represents a C++ namespace. This operand refers to **OpString** holding the name of the namespace. For anonymous C++ namespaces the name must be an empty string.

9+	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> <i>Set</i>	21	<id> <i>Source</i>	<i>Literal Number Line</i>	<i>Literal Number Column</i>	<id> <i>Parent</i>	Optional <id> <i>Name</i>
----	----	--------------------------------	-----------------------	--------------------	----	--------------------	------------------------------------	--------------------------------------	--------------------	------------------------------

## DebugLexicalBlockDiscriminator

Distinguish lexical blocks on a single line in the source program.

*Result Type* must be **OpTypeVoid**

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Parent* is a debug instructions describing the scope containing the current scope.

*Discriminator* is a single *word* literal denoting DWARF discriminator value for instructions in the lexical block.

8	12	<id> <i>Result Type</i>	<i>Result</i> <id>	<id> <i>Set</i>	22	<id> <i>Source</i>	<i>Literal Number Discriminator</i>	<id> <i>Parent</i>
---	----	--------------------------------	-----------------------	-----------------	----	--------------------	---	--------------------

## DebugScope

Provide information about source-level scope. This scope information applies to the instructions physically following this instruction, up to the first occurrence of any of the following: the next end of block, the next **DebugScope** instruction, or the next **DebugNoScope** instruction.

*Result Type* must be **OpTypeVoid**

*Scope* is a debugging instruction which describes source-level scope.

*Inlined* is an **DebugInlinedAt** instruction, which represents source-level scope and line number at which all instructions from the current scope were inlined.



6+	12	<id> Result Type	Result <id>	<id> Set	23	<id> Scope	Optional <id> Inlined At
----	----	---------------------	-------------	----------	----	------------	-----------------------------

### DebugNoScope

Discontinue previously declared by **DebugScope** source-level scope.

Result Type must be **OpTypeVoid**

5	12	<id> Result Type	Result <id>	<id> Set	24
---	----	---------------------	-------------	----------	----

### DebugInlinedAt

Represent source-level scope and line number for the range of inlined instructions grouped together by an **DebugScope** instruction.

Result Type must be **OpTypeVoid**

*Line* is a single *word* literal denoting the line number in the source file where the range of instructions were inlined.

*Scope* is a debug instruction representing a source-level scope at which the range of instructions were inlined.

*Inlined* is a debug instruction representing the next level of inlining in case of recursive inlining.

7+	12	<id> Result Type	Result <id>	<id> Set	25	Literal Number Line	<id> Scope	Optional <id> Inlined
----	----	---------------------	----------------	----------	----	------------------------	------------	--------------------------

## 4.8. Local Variables

## DebugLocalVariable

Describe a local variable.

*Result Type* must be **OpTypeVoid**

*Name* is an **OpString**, holding the name of the variable as it appears in the source program

*Type* is a debugging instruction which represents type of the local variable.

*Source* is an **OpSource** providing text of the primary source program this module was derived from.

*Line* is a single *word* literal denoting the source line number at which the local variable declaration appears in the *Source*

*Column* is a single *word* literal denoting column number at which the first character of the local variable declaration appears on the *Line*

*Parent* id of a debug instruction which represents parent lexical scope.

If *ArgNumber* operand presents, this instruction represents a function formal parameter.

1	1	<id>	Result	<id>	2	<id>	<id>	<id>	Literal	Literal	<id>	Optional
1	2	Result	t <id>	Set	6	Name	Type	Source	Number	Number	Parent	Literal
+		t Type							Line	Column		Number
												ArgNumber
												er

## DebugInlinedVariable

Describe an inlined local variable.

*Result Type* must be **OpTypeVoid**

*Variable* is a debug instruction representing a local variable which is inlined.

*Inlined* is an **DebugInlinedAt** instruction representing the inline location.

7+	12	<id>	Result <id>	<id> Set	27	<id> Variable	<id> Inlined
		Result Type					

## DebugDeclare

Define point of declaration of a local variable.

*Result Type* must be **OpTypeVoid**

*Local Variable* must be an id of **DebugLocalVariable**

*Variable* must be an id of **OpVariable** instruction which defines the local variable.

*Expression* must be an id of a **DebugExpression** instruction.

8	12	<id> Result Type	Result <id>	<id> Set	28	<id> Local Variable	<id> Variable	<id> Expression
---	----	------------------------	----------------	----------	----	------------------------	---------------	-----------------

### DebugValue

Represent changing of value of a local variable.

*Result Type* must be **OpTypeVoid**

*Local Variable* must be an id of [DebugLocalVariable](#)

*Value* is id of instruction, result of which is the new value of the *Local Variable*.

*Expression* is id of an [DebugExpression](#) instruction.

*Indexes* have the same semantics as corresponding operand(s) of **OpAccessChain**.

8+	12	<id> Result Type	Result <id>	<id> Set	29	<id> Local Variable	<id> Value	<id> Expression	<id>, <id>, ... Indexes
----	----	------------------------	----------------	----------	----	------------------------	------------	--------------------	----------------------------

### DebugOperation

Represent DWARF operation, that operate on a stack of values.

*Result Type* must be **OpTypeVoid**

*Operation* is a DWARF operation from the [DWARF Operations](#) table.

*Operands* are zero or more single *word* literals the *Operation* operates on.

6+	12	<id> Result Type	Result <id>	<id> Set	30	<a href="#">OpCode</a>	Optional <i>Literal Operands ...</i>
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### DebugExpression

Represent DWARF expressions, which describe how to compute a value or name location during debugging of a program. They are expressed in terms of DWARF operations that operate on a stack of values.

*Result Type* must be **OpTypeVoid**

*Operation* is zero or more ids of [DebugOperation](#).

5+	12	<id> Result Type	Result <id>	<id> Set	31	Optional <id>... Operation
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## 4.9. Macros

## DebugMacroDef

Represents a macro definition

*Result Type* must be **OpTypeVoid**

*Source* is id of **OpString**, which contains the name of the file which contains definition of the macro.

*Line* is line number in the source file at which the macro is defined. If *Line* is zero the macro definition is provided by compiler's command line argument.

*Name* is id of **OpString**, which contains the name of the macro as it appears in the source program. In the case of a function-like macro definition, no whitespace characters appear between the name of the defined macro and the following left parenthesis. Formal parameters are separated by a comma without any whitespace. Right parenthesis terminates the formal parameter list

*Value* is id of **OpString**, which contains text with definition of the macro.

7+	12	<id> Result Type	Result <id>	<id> Set	32	<id> Source	Literal Number Line	<id> Name	Optional Value
----	----	------------------------	----------------	----------	----	-------------	------------------------	-----------	-------------------

## DebugMacroUndef

Discontinue previous macro definition.

*Result Type* must be **OpTypeVoid**

*Source* is id of **OpString**, which contains the name of the file in which the macro is undefined

*Line* is line number in the source program at which the macro is rendered as undefined

*Macro* is id of **DebugMacroDef** which represent the macro to be undefined

8	12	<id> Result Type	Result <id>	<id> Set	33	<id> Source	Literal Number Line	<id> Macro
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# Chapter 5. Validation Rules

None.

# Chapter 6. Issues

1. Does the ABI used for the OpenCL C 2.0 blocks feature have to be declared somewhere else in the module?

**RESOLVED:** No. Block ABI is out of scope for this specification.

# Chapter 7. Revision History

Rev	Date	Author	Changes
0.99 Rev 1	2016-11-25	Alexey Sotkin	<b>Initial revision</b>
0.99 Rev 2	2016-12-08	Alexey Sotkin	Added details for the type instructions
0.99 Rev 3	2016-12-14	Alexey Sotkin	Added details for the rest of instructions
0.99 Rev 4	2016-12-21	Alexey Sotkin	Applied comments after review
0.99 Rev 5	2017-03-22	Alexey Sotkin	Format the specification as extended instruction set
0.99 Rev 6	2017-04-21	Alexey Sotkin	Adding File and Line operands
0.99 Rev 7	2017-06-05	Alexey Sotkin	Moving Flags to operands. Adding several new instructions.
0.99 Rev 8	2017-08-31	Alexey Sotkin	Replacing File operand by Source operand. Fixing typos. Formatting
0.99 Rev 9	2017-09-05	Alexey Sotkin	Clarifying representation of opaque types
0.99 Rev 10	2017-09-13	Alexey Sotkin	Support of multidimensional arrays. Adding DebugFunctionDeclaration. Updating debug operations.
0.99 Rev 11	2017-12-13	Alexey Sotkin	Removing "Op" prefix
0.99 Rev 12	2017-12-13	Alexey Sotkin	Changing style of enum tokens to CamelCase
1.00 Rev 1	2017-12-14	David Neto	Approved by SPIR WG on 2017-09-22. Change to 1.00 Rev 1